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CONTENTS.

EDITORIAL:
Advantages of Storage....1171
Two Central-Station Experts Wanted....1172
Popularizing the "Electric Home"....1173
Denies Control of Western Union....1174
New Western Union Directors....1174
Advanced Instruction in Electrical Engineering at the Massachusetts Institute of Technology....1174
Mr. Westinghouse, President of the American Society of Mechanical Engineers....1175
American Society of Mechanical Engineers, Annual Meeting....1176
Educating the Factory Owner....1179
Toledo Electrical Show....1179
The Plant of the Victoria Falls and Transvaal Power Company....1180
Electrical Exports for October....1181
Arrangements for the Chicago Electrical Show....1181
Centralized Light, Heat and Power in a Large Automobile Works....1182
Another Suit Brought Against the Economy Power Dam....1184
December Meeting of the Electrical Engineering Society of Columbia University....1185
Another Plan for Third Avenue Railway....1185
Navy Department Supplies....1185
CENTRAL STATION PRACTICE:
Development of Electrical Undertakings....1186
Cheap Power from Coke Oven Gas....1188
Hydroelectric Plant in Old-World Village....1188
A Review of Electrical Development in England....1188
TELEGRAPHY—TELEPHONY AND WIRELESS:
International Independent Telephone Association Convention at Chicago....1190
To Value Wire Lines....1192
ELECTRIC LIGHTING AND ILLUMINATING ENGINEERING:
Illuminating Engineering Society of Great Britain....1193
A New Method of Measuring Light Efficiency....1194
Saving the City Money....1195
ELECTRIC TRACTION:
Convention of the National Association of Railroad Commissioners....1196
Indiana Railroad Commission Urges Work on Block Signals....1198
Wires Over Railways to Be Improved....1198
Twelve Thousand-Volt Operation of Shore Line....1198
INDUSTRIAL POWER:
Modern Application of Electric Motors to Mine Hoisting....1199
Some Electrodynamic Storage Problems....1201
An Electric Groomer and Horse Clipper....1202
An Electrically Propelled Ship....1202
FINANCIAL REPORTS OF ELECTRICAL COMPANIES....1203
INDUSTRIAL SECTION:
Westinghouse Electric and Manufacturing Company's New Repair Department....1204
The Multinola; an Electrically Operated Multiple Phonograph....1205
A High-Tension Contactor Panel....1205
Arc-Lamp Illumination for Iron-Working Shops....1206
Flaming-Arc Lamps to Be Changed in Newark....1207
High-Tension Entrance Tubes....1207
New Type of Fuse....1207
CURRENT ELECTRICAL NEWS....1209
RECORD OF ELECTRICAL PATENTS....1216

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ADVANTAGES OF STORAGE.

Most drainage areas in the United States now yield only a small fraction of their possible energy in the form of water power, but a great increase may be obtained by means of storage.

A good illustration of the relatively large amount of work that may be done by quite small streams with the aid of storage is afforded by the Delta and Hinckley reservoirs that have been designed to supply water for the Rome summit level of the new Barge Canal in New York.

The lesser of these two reservoirs is to be created by a dam on the Mohawk River about five miles north of Rome, N. Y., at a point above which the drainage area is 137 square miles. By means of a dam 1,100 feet long and 100 feet high at the crest above the lowest foundation the reservoir will be given an area of 4.33 square miles, or 3.1 per cent of the drainage area.

Just behind the dam the water will be seventy feet deep below the crest, and its average depth over the reservoir will be about twenty-three feet, giving a capacity for 2,750,000,000 cubic feet. The crest of this dam is at elevation 550 feet above tide water, and at the gate house are four sixty-inch discharge pipes with their centers at elevation 481.5 feet, or 68.5 feet below the crest of the dam. After going over the spillway of this dam the water will follow the bed of the Mohawk to Rome, five miles below, and there enter the Barge Canal at elevation 420 feet above the sea. From the crest of the dam to the surface of the canal at Rome, the fall is thus 130 feet.

The present low-water flow of the Mohawk River at the site of the dam is about 100 cubic feet per second, and its maximum recorded flow is 8,200 cubic feet per second, giving a ratio of eighty-two to one between the maximum and minimum discharge. When the dam is completed it is estimated that the minimum flow from the reservoir in the driest years will be 188 cubic feet per second, or eighty-eight per cent more than at present, and that the maximum flow will be thirty-two per cent of what it is now.

As floods usually reduce the power of a hydroelectric plant by lowering the head of water on the wheels, it is evident that the increase of minimum flow and the decrease of the maximum would largely add to the output of a water power at the site of this reservoir.

The larger and more elevated of the two reservoirs under

consideration is to be created by a dam at Hinckley, N. Y., on West Canada Creek, about twenty miles north of Utica. Above the dam this creek has a drainage area of some 372 square miles, and the area of the reservoir will be 4.46 square miles, or 1.2 per cent of the drainage surface. For the creation of this reservoir a dam 3,800 feet long, with a maximum height of ninety feet, will be constructed, giving a depth of about seventy-five feet of water on the upstream side and an average of thirty-six feet over the entire area. At the level of the dam crest the reservoir is to have a capacity of 3,445,000,000 cubic feet, and all except 60,000,000 cubic feet of this water may be drawn off through four sixty-inch pipes of cast iron, which are provided with gates and valves.

At the crest of the spillway section the elevation of the dam is 1,225 feet above tide water, and the centers of the four discharge pipes are at elevation 1,169.5, giving a head of 555 feet on these pipes with the reservoir full. On leaving the reservoir the water will follow the natural bed of West Canada Creek for about five miles to a point near Trenton Falls and below the hydroelectric plant located there, whence energy is now transmitted to Utica. At times of low flow the elevation of the tailwater at this hydroelectric plant is about 754 feet above tide, or 471 feet below the crest of the Hinckley dam, and 415 feet below the centers of the discharge pipes mentioned above.

Not counting the friction loss in the pipe line, wheels supplied with water from this reservoir and discharged below the existing hydroelectric plant would thus have a water head of 415 to 471 feet.

The discharge of West Canada Creek at Trenton Falls runs as low as eighty-one cubic feet per second, and as high as 40,000 cubic feet, giving a ratio between maximum and minimum of nearly 500 to one. It is estimated that in the driest known year the reservoir will regulate the discharge of the creek at that point to a minimum of 518 cubic feet per second, with a minimum of about 1,000 cubic feet in an ordinary year. The reservoir will thus increase the minimum discharge of the creek to more than six times the present figures. At times of flood the reservoir will reduce the present maximum of 40,000 cubic feet per second to not more than 19,000 cubic feet, and thus prevent loss of head and damage by flood.

The Hudson River has a drainage area of 2,800 square miles above the Fort Edward dam, or nearly eight times that of West Canada Creek above Trenton Falls. At Fort Edward, however, the discharge of the Hudson falls below 600 cubic feet per second, or down to not more than the 518 cubic feet that may be had as a minimum in West Canada Creek by the use of the Hinckley reservoir.

While the hydroelectric plant at Trenton Falls now operates with a much less head of water than a pipe line from the Hinckley reservoir would give, this plant will get the benefit of the regulated discharge from the reservoir, and should be able to show a much larger output after the reservoir is completed.

If it be assumed that water from the Hinckley reservoir may be delivered by a pipe line to Trenton Falls under an average head of 400 feet, a minimum discharge of 500 cubic feet per second gives 22,700 gross or water horsepower amounting to sixty horsepower per square mile of drainage area. While the above reservoirs are designed for canal purposes, it is not unreasonable to expect that some change in the present statute will permit the electrical development of the fairly large and very constant powers that their construction makes possible.

At all events, these reservoirs serve as a strong object lesson of what may be done for the development of large and constant powers from comparatively limited drainage areas by the aid of suitable storage reservoirs.

New York, New England and the group of states that form the older South offer numerous situations where large storage areas at elevations of 500 to 2,000 feet may be created for power purposes, and as the advantages of such storage is more fully appreciated development will doubtless follow along these lines.

TWO CENTRAL-STATION EXPERTS WANTED.

In this age of specialization everything that tends to ultimate economy is not only a desideratum but an absolute necessity. There is no business man or head of a department of a business firm or corporation who is so well-informed that he cannot obtain ideas from outside sources that will enable him to cut down his operating expenses for the same output, to increase his turnover or profit for the same operating cost, or to increase his business or field of activity so as to bring in greater and increasing returns. The cleverest bookkeeper realizes the benefits of the periodical overhauling and analysis of his accounts by the expert accountant, and so it is with every specialist in his particular line.

This country has taken the lead in the matter of specialization and standardization of the mechanical industries, especially in the machinery and iron and steel trades. The result in these cases has been that notwithstanding the high cost of labor in this country, American products are able successfully to compete with those of foreign countries which have a superabundance of low-priced and efficient skilled labor.

In the great and growing field of central-station practice much good work has already been effected, but still more remains to be done. There is a paucity of information to be had regarding the operating costs of the multitudinous central electric-generating stations scattered throughout the country, but enough data are available to show beyond a doubt that in nearly all of them there is much room for improvement. Some good work has already been done by the various electrical associations and the prominent electrical journals toward the betterment of the existing conditions, and these leaders have been aided in no small

measure by the manufacturers interested in the problem.

The situation is not an easy one. Each central station presents its own definite problem depending largely on the peculiar elements introduced by local conditions. The type of plant best suited to a particular locality, for instance, depends on the kind of fuel or power available and on the character of the station load. If a good cheap supply of coal is ready to hand, a steam-driven plant may be advisable, and even if this is decided on, there is a multiplicity of engine types from which to choose. If good coal is dear and a poor quality of slack coal is available at a reasonable price, a gas-producer plant may prove to be the most economical. In special cases gas engines may be driven by natural gas, blast-furnace gas, peat-producer gas, etc. In large municipalities a refuse destructor may economically be used in conjunction with suitable boilers to furnish the power, or in other cases a waterpower may be conveniently situated close at hand.

All of these possibilities call for the services of the expert consultant, for a man who will specialize in this to the exclusion of all other business. He must be a man who can go into a locality which proposes to erect a central station, to examine and analyze carefully the local conditions without bias or partiality, and thus be able to report on the most efficient type of plant suited to the needs of that locality and adapted to the supplies of fuel or power available therein. Such a man is able to draw a still greater patronage from existing inefficient central stations. These he can subject to an exhaustive overhauling with a view to recommending changes in the existing plant, and in the operation thereof, which would tend to the greatest ultimate economy. In some cases, perhaps, where a complete remodeling of the existing plant might be inadvisable or even impossible under the circumstances, as for instance, on account of the capital cost involved, he might recommend less radical changes which would still be worth while the making. A man specializing along these lines speedily attains such a revenue of information as to make his services of value to almost any central station in the country, and with the continued improvements in central-station practice which are taking place, his periodical inspections and reports would be desirable for many years.

Another expert who is needed perhaps ever more than this man is an engineer who can specialize on load factors. It is unnecessary to point out that the services of a man who can improve the load factor of an existing central station would be even more valuable than the mythical philosopher's stone. There seems to be no reason why a specialist in this field should not develop. Each community has its own requirements, and a skilled engineer and investigator should be better competent to deal with such a problem than even the most enterprising and up-to-date central-station manager. Much desultory work along this line has been done already and many good ideas have been promulgated, a few of the most enterprising central stations having men in their organization who have done remarkable work in this direction, but there is still a great deal of room for improvement. The establishment of a day load to outside customers is largely if not entirely a matter for the local central-station managers, but this is not the only solution of the problem. In many cases it should be profitable for the central stations to establish subsidiary industries, as the manufacture of artificial ice, fertilizers, etc., for the utilization of their current in off-peak intervals. This is where the load-factor engineer would come in, so that he might, after examining the local conditions, recommend suitable types of plant, the operating and depreciation cost of which would not invalidate the good results thereby obtainable. In other words, the auxiliary plants would themselves have an expense account, and a load factor too, and these must be made compatible with the total operating costs of the central station to show an ultimate gain in percentage returns on the total expenditure.

The building up of data in connection with the first of the above recommendations might well be taken care of by the various electrical associations, but the second, that concerning the load-factor expert, would seem to be a question to be decided upon by the individual central stations.

It must be noted that there are many consulting engineers in this country who for several years have specialized more or less along the lines indicated above, but particularly on the engineering aspects of central-station practice. Some, in fact, have organized staffs on a large scale and make a business of taking over public utilities and operating them until they are placed on a sound commercial basis. Nevertheless there is an extremely large number of small central stations that do not avail themselves of the services of consulting engineering firms and these stations are the ones for whom an individual expert making careful studies of the actual conditions on the ground will be of the greatest service.

POPULARIZING THE "ELECTRIC HOME."

The attention of central-station men is especially directed to the Great Britain weekly letter in this issue. Herein is described a unique scheme adopted by a British central-station company for showing the possibilities of electricity in the modern home. The company in question has thoroughly equipped a typical residence from "cellar to roof" with electric lighting, and with electric heating, cooking, and other household appliances. The householder is furnished with this installation entirely free, on the understanding that he must afford every facility for inspection of the same to any "prospects" that the central station may send around with an order to view. The scheme is a novel one and calculated to afford the public an insight into the possibilities of electricity in the home which probably could not be so thoroughly attained in any other way.

Denies Control of Western Union.

The latest outcome of the investigating committee appointed for the purpose of determining whether the telephone companies should be placed under the Public Service Commission, has been the testimony of Theodore N. Vail, president of the American Telephone and Telegraph Company.

Mr. Vail gave the details of the negotiations which resulted in his company obtaining possession of $30,000,000 out of the $100,000,000 capital stock of the Western Union Telegraph Company. He intimated that the reason for taking stockin the Western Union was to build up a national system of combined telephony and telegraphy.

While admitting that he had purchased 30,00,000 of the total $100,000,000 stock of the Western Union Telegraph Company, Mr. Vail denied that the American Telegraph and Telephone Company controlled the Western Union Company and furthermore refused to state the price paid for the stock.

New Western Union Directors.

The American Telephone and Telegraph Company, which recently purchased about 28 per cent of the stock of the Western Union Telegraph Company, including the holdings of George J. Gould, put its representatives in the board of directors of the Western Union last week, when all of the Goulds, except George J. and Edwin, resigned along with seven other directors. An interesting feature was the election of Henry P. Davison, of J. P. Morgan & Company, who have been closely identified with the financing of the American Telephone and Telegraph Company, in association with Boston bankers. Lee, Higginson & Company, of Boston, are represented in the new board by Robert Winsor.

President Clowry remained in the directorate and the American Telephone and Telegraph Company's president, Theodore N. Vail, was elected to one of the vacancies.

Other newly-elected directors were Judge Robert S. Lovett, of the Harriman system, William H. Moore, of the Rock Island Company, and these American Telephone and Telegraph men: Henry S. Howe, John I. Waterbury, Edward J. Hall, Union N. Bethel and H. B. Thayer.

It is understood that George J. Gould and Edwin Gould offered their resignations, but were requested to remain.

Advanced Instruction in Electrical Engineering at the Massachusetts Institute of Technology.

During the past year, the regulations for the degree of Doctor of Engineering at the Massachusetts Institute of Technology have been made more definite and have been placed in the hands of the board which also administers the regulations for the degree of Doctor of Philosophy. The requirements for these two degrees have now been made substantially equivalent, as far as the period of study and the candidate's attainments are concerned. The executive committee has voted to maintain two Austin research fellowships carrying a grant of $500 each and the remission of tuition fees, which are now to be open equally to candidates for the Doctor of Engineering and Doctor of Philosophy degrees. In addition to these Austin fellowships, other graduate scholarships and fellowships are maintained, numbering fifteen this year.

During the present year seventeen candidates for advanced degrees have been awarded fellowships or graduate scholarships. Two of these were for the encouragement of advanced study in Germany by graduates of the Institute and the remainder for the encouragement of advanced study in the Massachusetts Institute of Technology.

The number of candidates for the doctor's degrees in engineering and philosophy have this year increased largely over the number of candidates last year. The increasing importance of this work at the Institute has led to a more effective organization of the arrangements for carrying on the work.

The number of students entered as candidates for the master's degree are also considerably increased over last year.

The advanced instruction in the theory of alternating currents and electrical transmission of power accompanied by advanced research is continued this year under the direction of Dr. Harold Pender, whose investigations in these branches are well known. Professor Pender's duties in the electrical engineering staff of the institute of Technology include the direction of the important undergraduate course in the elements of electrical engineering which is provided for the junior students in electrical engineering and electrochemistry, and the naval constructors who are detailed by the United States Government for study at the Institute, and also include the advanced lectures for graduate students just referred to on alternating currents and the transmission of power and the investigations and research carried on by such students. Other work carried on by the department for the benefit of students desiring to do original research or who are studying with a view to obtaining advanced degrees, include the lectures and investigations under Prof. Dugald C. Jackson on the organization and administration of public service corporations, and instruction in the designing of electric plants by Professor Wickenden.

In addition to the growing importance of the advanced study and research carried on by the electrical engineering department at the Institute, the undergraduate classes are growing rapidly, and this is particularly true of the junior and senior classes which are recruited to a considerable degree by graduates from the humanistic or scientific courses of other institutions. Forty per cent of the men who graduated from the electrical engineering course of the Institute at the last commencement had previously received college degrees and had thereafter spent from one to three years in the electrical engineering studies at the Institute of Technology. The increased number of students following the electrical engineering instruction is particularly felt in the laboratories and the number of student hours of instruction in the electrical engineering laboratory is now approaching a figure about twice as great as it was three years ago.

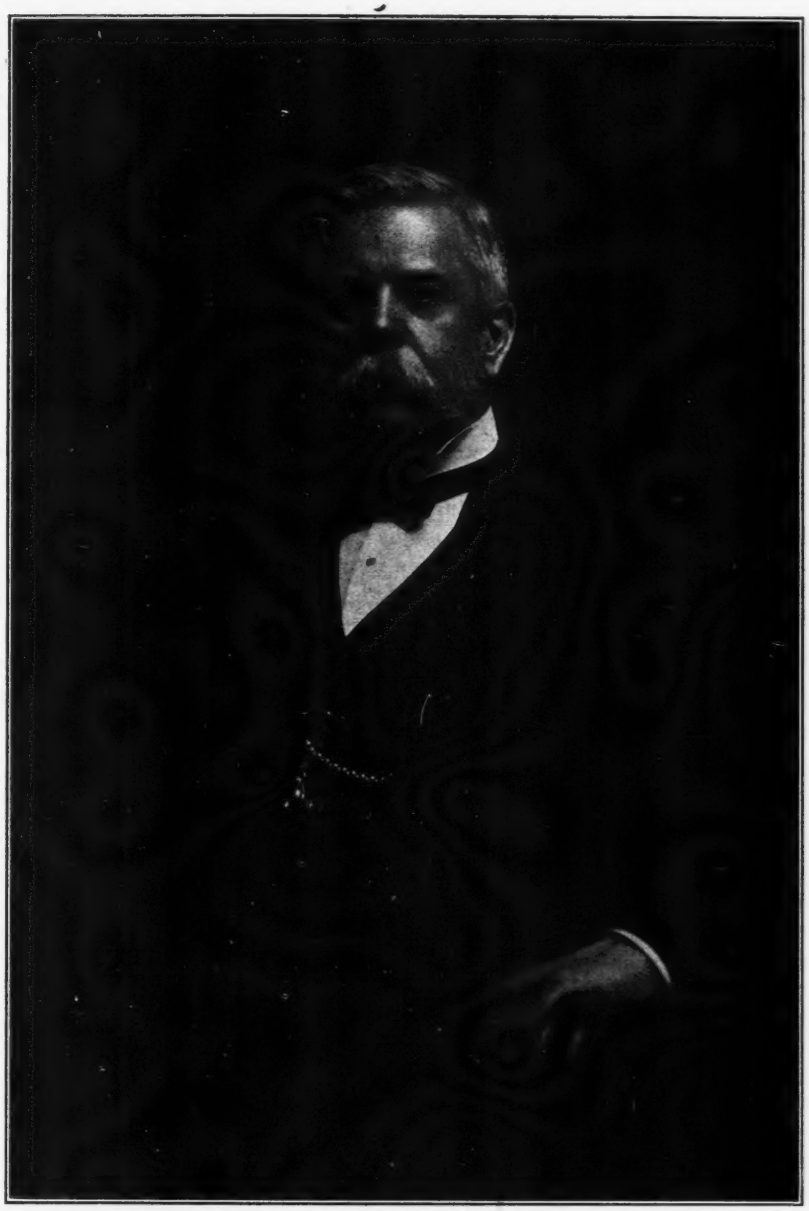
Joint Meeting in Chicago.

The next joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers will be held on the evening of December 22 at the latter society's rooms in the Monadnock Block, Chicago. Ralph H. Rice, assistant engineer of the Board of Supervising Engineers, Chicago Traction, will present a paper on "Low-Tension Street-Railway Feeder Systems."

Wireless Joins England and Germany.

A cablegram from Berlin last Wednesday stated that the first direct wireless communication was established between England and Germany when messages were exchanged on that day between Brunswick and London.

Mr. Westinghouse, President of the American Society of Mechanical Engineers.



GEORGE WESTINGHOUSE.
The American Society of Mechanical Engin eers Elected Him President at the Thirtieth Annual Convention, Held December 8, 1909.

"Escorted by three former presidents, Mr. Westinghouse took his place on the platform. He was applauded by seven hundred engineers, their wives and friends. Then there was a reception." So reads the brief paragraph in a New York newspaper. And there should have been a reception; and it must have been a proud moment for those three former presidents to escort this strong man of invention, organization, and financing to the rostrum where he was hailed as the chief executive of one of the leading national engineering societies.

George Westinghouse is a leading exponent of the adaptability of inventive genius to the co-ordinated efforts of investing and manufacturing, and has exemplified in countless ways the true conception of the meaning of engineering: "The utilization of the world's resources for the benefit of mankind."

Mr. Westinghouse's father before him was a prominent manufacturer, and the old factory of George Westinghouse & Company is still a landmark in Schenectady, N. Y. Mr. Westinghouse was born at Central Bridge, Schoharie County, New York, October 6, 1846. He spent many of his earlier days in his father's machine shop, inventing, at the age of fifteen, a rotary engine. He was a member of the 12th New York National Guard and of the 16th New York cavalry in the Union Army from June, 1863, to November, 1864, when, making good use of his remarkable inventive and mechanical talent he became assistant engineer in the United States Navy, retiring in August, 1865. He attended Union College after this until the sophomore year, from which college, by the way, he received the degree of Doctor of Philosophy in 1890. In 1865 he invented a successful railroad frog for replacing derailed cars, and it was shortly after this that he made his very important invention of the air brake. Since that time he has introduced various improvements which have been of almost as great value as the original invention, and the high speeds at which our railroads operate in safety today are due largely to the inventive skill and methods of manufacture introduced by this pioneer in the production of modern railway appliances.

There is one thing throughout the entire career of Mr. Westinghouse which stands out more prominently than any other. This is his ability to take off his coat and go to work to save a situation which apparently was going wrong. And time and again he has devoted his entire private fortune and all the great ability he has been capable of to the protection of the investments of those who, with confidence in him, have made their investments in the enterprises for which he stood sponsor. The introduction of the air brake, the development and utilization of electro-pneumatic signaling devices, the introduction of the alternating-current system for transmission, for lighting and power, all received their greatest impetus from the determined and successful work which Mr. Westinghouse initiated. In the electrical field the inventions of Stanley and Tesla in alternating-current phenomena, the work of von Welsbach and Walther Nernst on the Nernst glower, the work of Peter Cooper Hewitt on the mercury-vapor lamp, the work of Bremer on the flaming arc, and many others have been backed by Mr. Westinghouse. And although all these were revolutionary in their inceptions they have become stable and a part of common engineering practice largely because of the unfaltering determination of this man who brought to invention the assistance of capital and the possibilities of great manufacturing facilities.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

ANNUAL MEETING, NEW YORK, DECEMBER 8, 9 AND 10.

The first session of the annual meeting of the American Society of Mechanical Engineers in New York was held on Wednesday morning, December 8. The session was a purely business one, being devoted to the reports of the tellers of election and of standing committees. George Westinghouse was elected president for the ensuing year. Among the reports presented were those of the gas power sections committee on standardization and on plant operations. The report of the standardization committee considered the following subjects: The making of certain general recommendations acceptable to all good engineers; defining specifically those terms or conditions whose interpretation seems to be a matter of agreement and practice; and pointing out where the difficulty lies in the remaining cases, in which, due to insufficient progress there is not a complete understanding or agreement. The committee stated that the capacity of a unit may be considered as its output in some unit, and its efficiency the ratio of output to input measured in the same units. The capacity and efficiency of engines, producers and complete plants will be defined when definitions are fixed for: (a) Input of producers; (b) output of producers = input of engines (when all gas generated is taken by the engine); (c) output of engine. To these must be added a definition of regulation of each unit and the adaptability or suitability of fuel supply to the needs of the unit. These are (d) Regulation of producers; (e) Regulation of engines; (f) Adaptability of coal for producers; (g) Adaptability of gas for engines. The report then defines these various terms and shows that a further definition of a number of other conditions is necessary, including quality and quantity of coal consumed together with its thermal equivalent, the quality, quantity and thermal equivalent of gas, the horsepower of engines and variation of horsepower, the consecutive time producers may continue to deliver gas of defined quality and quantity, or engines to deliver defined horsepower, the number of revolutions in any time interval together with variations, the time interval for the completion of any number of revolutions and the change in the time intervals with the number of revolutions chosen for observations or with load conditions of the engine, the physical or chemical condition of coal not included in the quality definition but affecting the adaptability of the producer, the physical or chemical condition of the gases not included in the quality definition, but affecting the adaptability to the engine. These various definitions are discussed in considerable detail in the report and recommendations made regarding them.

Following this, the report of the plant operation committee was taken up. This presents a series of blanks for recording data, by means of which the various features of gas engine plant operation can be studied, together with recommendations and discussion of the blanks. The discussion on both of these reports was voluminous and they were adopted at the meeting of the gas power section the next day.

The first regular professional session was held on Thursday morning. Four papers were presented and formed a symposium on measuring the flow of fluids. They were entitled, respectively, "Tests on a Venturi Meter for Boiler Feed," by C. M. Allen; "The Pitot Tube as a Steam Meter," by Prof. George F. Gebhardt; "Efficiency Tests of Steam Nozzles," by Prof. F. H. Sibley and T. S. Kemble: "An Electric Gas Meter," by Prof. Carl C. Thomas.

The object of the tests with the Venturi meter was to determine how well adapted it would be for use in measuring the feed to a boiler, in view of the variety of conditions under which it might have to operate. The methods of pumping the water through the meter, the different temperatures of the water pumped, various and fluctuating pressures and velocities of flow—any one or several of these conditions might be met with in actual service, and the results obtained indicate that such occurrence would have practically no effect on the satisfactory performance of the work of the meter. However, there are limits to this satisfactory operation of any one meter, and the lower limit for this size seems to be reached when the velocity of the water through its throat becomes lower than about ten feet per second. In case the desired amount of water is smaller than the quantity which would produce this velocity in the meter, a smaller meter would be installed. It is evident from these tests that the Venturi meter is sufficiently accurate for the majority of commercial or engineering requirements.

Professor Gebhardt's paper on the Pitot tube is in abstract as follows:

The application of a Pitot tube system along the lines described in the paper is an accurate means of determining the velocity of steam at any point in a pipe, provided the values of the various influencing factors are known; and for straight lengths of piping with continuous flow, under these conditions, it is an accurate means of determining the weight of steam flowing. Under average commercial conditions in which the pressure and quality of the steam fluctuate and an average value must be taken for the density of the self-adjusting water column, only approximate results can be obtained, the extent of error varying with the degree of fluctuation. For velocities in excess of those corresponding to a one and one-half-inch water column (about 2,000 feet per minute for pressures over seventy pounds gage pressure), tests gave a maximum error of about two per cent for continuous flow in straight lengths of piping.

The paper by Professor Sibley and Mr. Kemble is the result of a series of tests begun in 1905 at Case School of Applied Science to determine the proper proportions and efficiency of steam turbine nozzles for given steam conditions. The paper gives the final tests, and in brief is as follows:

Two methods were tried out for finding the efficiency: (a) by first finding the pressure in the nozzle by means of a search tube placed axially in the nozzle; (b) by finding the reaction of the nozzle. This was done by suspending the nozzle in an air-tight box at the end of a flexible steel tube. The deflection of the tube caused by the reaction of the nozzle, was measured by a calibrated spring. Friction was eliminated. Preliminary work was done to calibrate the springs to determine the volume of flow of the various nozzles and to determine the pressure in the nozzle and the surrounding medium. The results of the tests indicate: (a) that the reaction is affected by a difference in pressure between the muzzle of the nozzle and the medium surrounding the nozzle; (b) that the efficiencies of the various nozzles were determined within a probable error of two per cent; (c) that the efficiency is affected more by the smoothness of finish on the inside of the nozzle than by the exact contour of the nozzle.

Quite a little discussion on this paper ensued, and it was stated that the high efficiency attained would be surprising to one not familiar with recent developments in the design of nozzles. The effect of moisture in the steam may be overcome by the use of superheated steam, and it is also possible that more data are necessary as to the proper lengths of nozzles.

The electric gas meter described by Professor Thomas in his paper is a meter for measuring the rate of flow of gas or air, which can be adapted for use as a steam meter or as a steam calorimeter, taking the quality of all the steam passing through a pipe instead of that of a sample of steam. The meter consists of an electric heater formed of suitable resistance material disposed across the gas passage so as to impart heat at a uniform rate to the gas. The resulting rise of temperature is measured and autographically recorded by means of two electrical resistance thermometers, one on each side of the heater. These consist of resistance-wire wound upon metal tubes so placed that all the gas passing through the meter comes in close proximity to the thermometers. The adoption of this principle of operation is stated to permit the construction of a very accurate and sensitive autographic meter of large capacity containing no moving parts in the gas passage; independent of fluctuations in pressure and temperature of the gas; capable of measuring gas or air at either high or low pressures or temperatures. The electrical energy required is about 1 kilowatt per 50,000 cubic feet hourly capacity, at the pressures ordinarily used in gas mains.

The principle of operation is that a certain known quantity of heat is added electrically to the fluid flowing through the meter and the rate of flow is determined by the rise in temperature of the fluid between the inlet and the outlet of the meter. This paper provoked quite a little discussion in which it was pointed out that the possibility of error in this type of meter must be carefully examined. The volumes recorded by the meter are not actual volumes, but must be reduced to some known standard of temperature and pressure. There are possibilities of errors in measuring blast furnace gas with a meter of this type, if it has gone through washers, due to the moisture in the gas. This might amount to twenty-five per cent if the gas is supersaturated with vapor. The method of calibration was criticized and it was shown that there were large possibilities of error if the gases measured were of different analyses from the gas with which the meter was calibrated, and also if the gases were of different specific heat. To one speaker it did not seem possible to calibrate the instrument for illuminating gas at one locality and use the same calibration for measurement of illuminating gas at another locality. It did not seem that the instrument could be used for accurate work unless constant analyses were made of the gases. Another speaker questioned whether the thermometers, due to the construction of the meter, gave the true average temperature of the gas. Inquiry was made as to the effect of the deposition of impurities from the gas on the resistance grids, but the author pointed out that this deposition had little or no effect, inasmuch as the heat is generated in the gas and could pass to no place but the gas itself.

At the regular session on Thursday afternoon the papers presented dealt with steam engineering. David M. Myers presented one on "Tan Bark as a Boiler Fuel," an abstract of which is given below.

The average fuel value of spent hemlock tan is about 9,500 bituminous test units per pound of dry matter, which is about 35 per cent of its total moist weight in the fireroom. The available heat value per pounds as fired is 2,665 bituminous test units. One ton of air-dry hemlock bark produces boiler fuel equal to 0.42 tons of 13,500 bituminous test units coal. The degree of leaching does not affect the number of heat units per pound of dry matter, but of course reduces the available material. Boiler tests under normal conditions show thermal efficiencies of from fifty-eight to sixty-eight per cent, and a higher efficiency has been obtained under special conditions.

Tan presses have produced no marked increase in boiler and furnace efficiency when tested. Grate surfaces should be materially reduced when tan is pressed. Mixing coal with tan under proper conditions increases both the capacity and the efficiency of the boiler and furnace.

Conditions productive of best results have been: ample combustion space, and a refractory arch over the entire grate; no less than 0.5 inch and preferably 0.6 inch water-gauge draft with ample draft passages; feeding through holes in top of furnace in small quantities and at frequent intervals to approximate the rate of combustion; constant care to prevent blow-holes; a small shallow-fired furnace; a high arch above the fire (which is about the most important single requirement); proper ratio of heating surface to grate surface for local conditions; the pressing of tan under certain conditions.

The next paper was on cooling tower practice and was presented by J. R. Bibbins.

Developments of recent years in both steam and power plants have demonstrated the usefulness of the cooling tower. It is true that in some plants the maximum effectiveness of the cooling tower and that of the condensing plant are in a sense diametrically opposed. The tower works best when the vacuum is lowest. On the other hand this tends to a general operative equilibrium. Fortunately, improvements in condensers are being actively pushed, the trend being to secure higher hot-well temperatures. This immediately enhances the effectiveness of the cooling tower. Similarly, in gas-power plants, the possibility of cooling jacket water by means of this apparatus is favored by the high temperatures of discharge which prevail in engines of good construction. It is not an impossible state of affairs for the jacket water in a gas-power plant to cost more than the fuel, if not cooled and used over again, so that from all standpoints the cooling tower is worthy of careful study.

The deductions of the author were questioned in the succeeding discussion and the quotations of prices of forced draft towers suitable for a load of several thousand kilowatts, not including the motor or engine for driving the fan, as obtained by Mr. Bibbins from a number of builders, and which were given in the paper as ranging between $4.80 and $6.93 per kilowatt were considered high. The prices, it was stated, must have been made on an installation for minimum service conditions. While cooling towers have been in use in the United States for twenty-five years, the first installation having been made in 1884, for more than ten years their design has been on a scientific basis, and their building is now an engineering specialty. The reason of their restricted use in this country is not the excessive cost of towers nor the lack of knowledge of their construction, but rather the fact that good water supplies are more plentiful in this country than abroad. As many of the statements in the paper were questioned in the discussion the author preferred to reply to it in writing rather than with an oral closure.

"Governing Rolling Mill Engines" was the title of a paper presented by W. P. Caine.

The paper describes first the types of rolling mills and the engines driving them; analyzes the distribution of power, the design and the operation of the engines, calling attention to causes of low steam economy, high repair changes and the danger of broken flywheels; describes and gives indicator cards and speed curves of a Corliss engine driving a three-high mill under two different conditions of governing, (a) under the widest range of adjustment of cut-off, (b) under a limited range, increasing the economy and making the engine run much more smoothly and safely. It also gives the reasons for the different results shown. A table is given showing the power required for rolling in the mill and the momentary source of the energy, whether from the cylinder or flywheel. A diagram shows this graphically. A description is also given of the tachometer used to take the speed curves.

Henry C. Ord stated, in discussing the paper, that the conservation of energy as applied to rolling mills had received but little attention until lately. The continuous indicator and the recording tachometer were the first means offered to measure the power required to roll a given piece of steel. Steel manufacturers prefer two-high reversing mills to three-high mills, because they can be easily reversed should a piece not enter the rolls properly. For this reason certain modern three-high electric motor-driven rolls are provided with an emergency reversing device which can also be used as a quick safety stop in case of accident. Two-high mills do not have the complications of three-high mills, there being fewer rolls and no table raising and lowering mechanism. The power required for the tilting table mechanism should be charged to the three-high mill, although power is not the only consideration. A serious question is that of a maximum tonnage in a minimum time.

Another speaker gave it as his opinion that but little if any advantage can be gained in any blooming mill work with the three-high mill if it is steam driven. The only economy to be obtained over present practice will be by means of the two-high reversing mill electrically-driven. Such an equipment should have the necessary power to avoid delay in gripping the ingot, the means for instantly cutting out the power at the release of the ingot and also a continuously running steam engine with a sufficiently heavy flywheel at the generator.

An experience with leaky vertical fire tube boilers formed the subject of a paper by F. W. Dean.

This paper discusses the difficulties expe-

rienced with some large vertical boilers somewhat over ten feet in diameter, and containing 6,000 square feet of heating surface. The boilers leaked badly soon after being started and nothing that was done improved their condition until the water legs were lengthened from two feet to seven feet, two and three-quarter inches. The boilers were raised five feet two and three-quarter inches. Before they were raised the lower ends of the tubes would cover with very hard clinker and become stopped up. This clinker could be removed only by cutting it off when the boilers were cold. After the boilers were raised, a light clinker that could be blown off formed about the tubes; by removing this by blowing every three or four hours the leaks were stopped and they have never returned. The trouble varied with different kinds of coal. Each boiler had been run constantly at over 1,000-horsepower, and the economy seemed to be about the same no matter what the power was. So far it has been difficult to obtain good combustion, but the heat-absorbing power of the boilers is admirable. The experience with these boilers indicates that there is no ordinary limit to the size of a vertical fire-tube boiler.

Prof. L. P. Breckenridge said that the paper was of great value as it recorded a failure, the usual practice in preparing papers being only to present successful construction. The consensus of opinion was that the combustion chamber was too small and the tubes in the boiler entirely too long. The deposit at the end of the tubes was thought to be principally carbon. Colonel E. D. Meier gave an experience with boilers at the World's Fair, Chicago, burning oil fuel, all of which lost tubes. It was deemed impossible to account for this fact, but later the boilers exhibited by Colonel Meier were shipped to California and no further trouble was encountered with the tubes despite the use of oil fuel. The burners at Chicago were directed downward and it was believed the drops of oil not thoroughly vaporized were deposited on the tubes at the Chicago plant, the carbon of the oil adhering to the tubes. This caused blisters which in a short time resulted in the tubes burning out.

F. W. Dean then presented another paper entitled "The Best Form of Longitudinal Joints for Boilers."

This paper deals specially with the defects of the usual form of butt joint used on the longitudinal seams of boilers, in which the inside strap is wider than the outside strap.

While stating that there has never been an explosion of a horizontal return tubular boiler built with the ordinary form of butt joint, the author gives an example of the rupture of such a joint that would have resulted in an explosion. The joint recommended as a substitute for this is one that has the inside and outside straps of the same width, but the outer row of rivets is made with a wide pitch and the straps are made sufficiently thick to stand caulking between the widely pitched rivets. Ordinarily the efficiency of this substitute joint is from eighty-four to eighty-five per cent, but it can be made as great as that of any other form of joint, if the pitch of the rivets is wide enough, in which case the straps would have to be thicker than would otherwise be necessary.

At the meeting of the gas power section held simultaneously with the regular session Thursday afternoon, the reports above recorded were received and accepted after the chairman, F. R. Low, had read a report outlining the work of the section for the past year. After the announcement of the election of J. R. Bibbins to the chairmanship of this section for the ensuing year, a paper entitled "Testing Suction Gas Producers with a Koerting Ejector," by C. M. Garland and A. P. Kratz, was read.

The paper describes a method of testing the suction gas producer which is independent of the engine. The engine is blanked off from the producer and a Schutte & Koerting steam ejector is inserted, which draws the gases from the producer and delivers them to a scrubber in which the steam used by the ejector.

The results of one test are included in the article together with a graphical log illustrating the conditions during this test.

In the discussion it developed that the speakers did not regard the orifice method of measuring gas as absolutely reliable, and it was pointed out that the variation of steam required in the operation of the producer was due to the variations in conditions of running and not to errors of observation. It was also pointed out that the depth of fuel bed was too great, and that the fuel bed should have been brought to a normal condition by means of a three-day preliminary run instead of starting with a clear fire. The combustion, it was pointed out, was far too high, being about thirty-four pounds per square foot of grate surface per hour whereas ten to fifteen pounds was nearer to average practice. It was also pointed out that the paper gave evidence that the fuel bed as described in the paper was not in the same condition at the end as at the beginning of the test, which left the accuracy of the paper open to serious question. In reply to a question by one of the speakers, it was stated that the producer efficiency does not seem to change from 20 per cent to 100 per cent of normal full load.

Following this paper, "A Bituminous Gas Producer of the Double Zone," was described in a paper by J. R. Bibbins.

Much time and money has been spent by the various manufacturers in the development of a tar-free gas producer and in some respects the obstacles have seemed insuperable. Every advance is therefore of interest and importance and it has seemed worth while to report a long series of tests conducted by the builder of the producer described in the paper to determine the net results under commercial conditions, whether good or bad. These tests are characterized by their unusual duration and absence of outside conditions affecting the results. These results in general will speak for themselves and it is necessary simply to emphasize the fact that continuous operation has been secured with tar-free gas of reasonable heat value and producer efficiency and an over-all plant economy of about one pound of fair bituminous coal per brake horsepower (proportionate economies for poorer grades). More important still, the fact has been developed that the efficiency and general effectiveness of operation of the producer on low-grade fuel, lignites, etc., is practically as high as with the higher grades. This places within the reach of the producer the enormous fuel deposits of the West and South, which are practically invaluable for steam work.

The discussion on this paper was voluminous and devoted mostly to criticisms of the producer described and to the relation of experiences obtained in its operation.

The final sesison was held Friday morning and comprised papers on various engineering subjects. The Bucyrus locomotive pile driver was described in a paper by Walter Ferris. The paper attracting the greatest attention was that entitled "Line Shaft Efficiency, Mechanical and Economic," by Henry Hess.

This is the description of a complete test of the relative efficiency of a lineshaft of $2\frac{7}{16}$ inches diameter, making 214 revolutions per minute, with a bearing load due to the weight of the parts plus the tension of the belts subjected to known stress by counterweighting, when running in ring-oiling babbitted bearings and when mounted in ball bearings. Sixteen tests, each of forty minutes' duration, with belt tensions of twenty pounds to ninety pounds per inch width of single belt, were carried out. The instruments by which the electric energy consumed was measured, as well as all other instruments and the motor, were calibrated before and after the tests. The savings in power consequent on this change ranged from fourteen to sixty-five per cent, with thirty-six and thirty-five per cent under average conditions of good practice, due to belt tensions of forty-four pounds and fifty-seven pounds per inch width of single belt respectively. The paper gives data for determining the power savings that may be expected in various plants, as a percentage of the plain bearing shaft friction and as a percentage of the total power consumption; also exact figures taking into account extra investment, depreciation, maintenance, interest on extra investment and power savings, which show that for the plant tested and described the savings represent thirty-seven per cent per annum.

The speakers discussing the paper agreed that it was of great value but Professor Carpenter stated that the friction load was preferable as a unit of measurement to the coefficient of friction, inasmuch as it was a more constant quantity. Another speaker presented the term "watts per bearing" as a convenient one for measurement. This is obtained by measuring the current required by the motor to drive the line shaft and by counting the

number of bearings and loose pulleys. The quotient of the total watts by the number of bearings and loose pulleys gives the energy required per bearing. Results of a number of tests were given showing the watts required per bearing with various sizes of shafts. One-inch shafts at 400 revolutions per minute required 27 watts per bearing, one and one-half inch shafts at 300 revolutions per minute required 66 watts, two-inch shafts at 190 to 250 revolutions per minute required 99.1 watts, two and one-half-inch shafts at 200 to 250 revolutions per minutes required 108 watts per bearing. These results were the average of a large number of tests.

In a general discussion of the subject, it was stated that roller bearings had been applied to railway cars with a consequent reduction in the motive power required. Another speaker stated that the coefficient of friction in railway service was already very low, and the author in his closure stated that the main object of ball bearings in railway service is not the elimination of friction but the getting rid of other troubles, such as those of lubrication. A hot box is unknown with ball bearings. In electric railway service an important result of the use of ball bearings is the ability to coast, with a resulting saving of power required on the system of sometimes as much as 30 per cent.

Two other papers, both by A. F. Nagle, were read at this session. The first was entitled "Pump Valves and Valve Areas."

This paper is designed to call the attention of engineers to the need of reviewing the common notion that "valve-seat area" is synonymous with "velocity of flow." It is evidently the purpose of specifications for pumping engines to secure a low velocity of flow through the valves, thus reducing the head required to force water through the pump; but to accomplish this laudable purpose, special and intelligent attention should be given to the springs of the valves, rather than to valve-seat areas. If that be done, valve-seat areas need not be greater than the plunger area for the vertical triple-expansion pumping engines so largely used in city pumps. A slight economy in both construction and operation could be effected by giving more study to the proper design and strength of springs for pump valves.

The discussion on this paper was principally in regard to points in the field of machine design. The second paper was "A Report on Cast Iron Test Bars."

This paper is designed to show engineers that test pieces, whether cast in separate molds or in the same mold as the main casting, are not perfect indications of the character of the iron in the main casting. In other words, uniformity of results is not found in practice where we know of no reason why they should not be uniform. These test bars were used in the construction of over 3,000,000 pounds of pumping-engine castings, involving soft and hard irons for the various parts. Tables 5, 6 and 7 would indicate a probable variation of fifteen per cent where uniformity might be expected.

This provoked but little oral discussion and but one written discussion, which was of a highly mathematical nature.

Educating the Factory Owner.

The following commentary on Dr. Gisbert Kapp's presidential address to the Institution of Electrical Engineers in England, which appeared in a recent issue of the London *Times*, should prove of interest:

"In itself a summary, the inaugural address of Dr. Gisbert Kapp, the president of the Institution of Electrical Engineers, does not lend itself to any attempt to summarize its content as the basis of any controversial theory. There will certainly be no such dialectical outburst as followed Mr. Mordey's famous utterance of a year ago. Indeed, as far as Doctor Kapp allows any echo of that discussion to make itself heard, his only reference suggests that he has in the meantime discovered in what respect, and how far, we [*i. e.*, English electrical manufacturers] are 'backward,' namely, in the comparative slowness of our adoption of the industrial and social uses of electricity.

"The greatest and most stubborn obstacle to electrical progress in this country (England) is to be found in the complacency of factory owners who will not even consider the claims of electric driving, although it may be almost universally adopted, for sufficient reasons, by their foreign competitors. In no other manufacturing country is there any parallel, for example, to the self-inflicted blindness of our textile industry, and in such circumstances it is to be regretted that Doctor Kapp, instead of covering such an extensive field in his survey, did not devote his address almost exclusively to the enormous benefits to be attained through the more rapid application of electricity to textile and other factory purposes.

"The one point on which all ranks and sections of the profession are unanimously agreed is that the use made of electricity is not sufficient, and whatever difference of opinion there may be otherwise on the subject of 'backwardness,' it is plainly important that, from the president downwards, electrical engineers should be more concerned with the education of the factory owner than the detail improvements in traction motors and other apparatus."

Toledo Electrical Show.

As previously mentioned the first annual electrical show of Toledo, O., will be held in the Coliseum Building, January 31 to February 5, under the auspicies of the Electrical Dealers' Association of that city.

A space chart has been distributed showing the locations of the booths, many of which have already been engaged, and the prices quoted include the space, booth and sign.

The preliminary interest shown in this exposition indicates that the event will be a decided success and it is believed that the Electrical Dealers' Association will feel justified in holding a show annually hereafter.

President T. D. Buckwell and Secretary I. G. Golden, of the association, are the managing directors of the show.

McCall's Ferry Power Plant Sold.

Henry F. Brown, special master, on December 7, sold all the real and personal property of the McCall's Ferry Power Company at public sale to William M. Barnum, of New York, for $2,000,000. His was the only bid and it is understood he represents the majority bondholders.

The company was engaged in building a 100,000 horsepower hydroelectric plant along the Susquehanna River at McCall's Ferry, Pa., and was unable to proceed with the work after the failure of the Knickerbocker Trust Company, of New York, which was financing the project. The plant was described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of February 27, 1909, page 380.

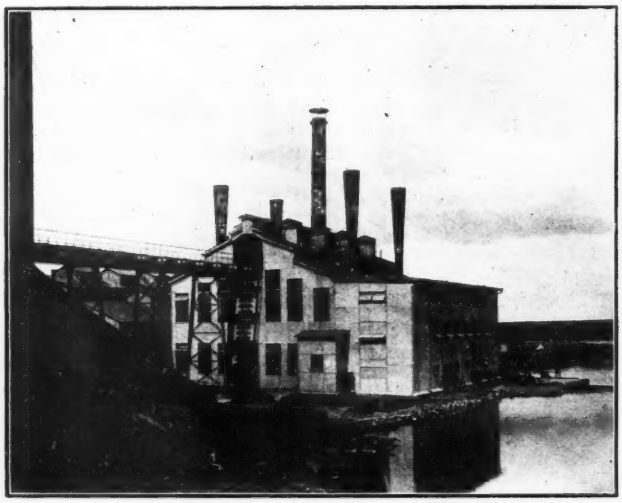
A Europe-Argentine Cable.

An American Consul-General reports that the President of the Argentine Republic has signed the bill approving the contract with John Oldham, representing the Western Telegraph Company, for the construction of a direct cable between the Argentine Republic and the continent of Europe. This contract nowhere refers to radiographic communications. All advantages, profits, and privileges accorded to the company, as well as any restrictions thereby imposed on the Argentine Government to conclude new contracts in such manner as it may deem advisable, are limited to twenty-five years.

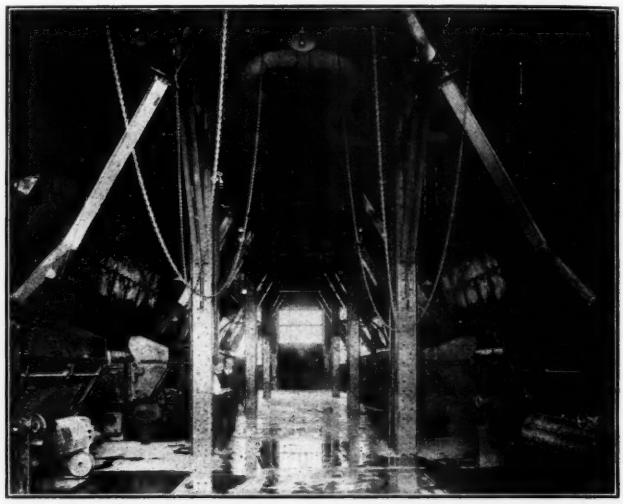
THE PLANT OF THE VICTORIA FALLS AND TRANSVAAL POWER COMPANY.

BY DR. ALFRED GRADENWITZ.

Some problems connected with the installation of the huge power plant of the Victoria Falls and Transvaal Power Company have been recently solved satisfactorily, so that its future can be considered as fully warranted. A short description of this imposing scheme, together with a few photographs showing the Brakpan central station, would therefore seem to be interesting.



CENTRAL STATION AT BRAKPAN.



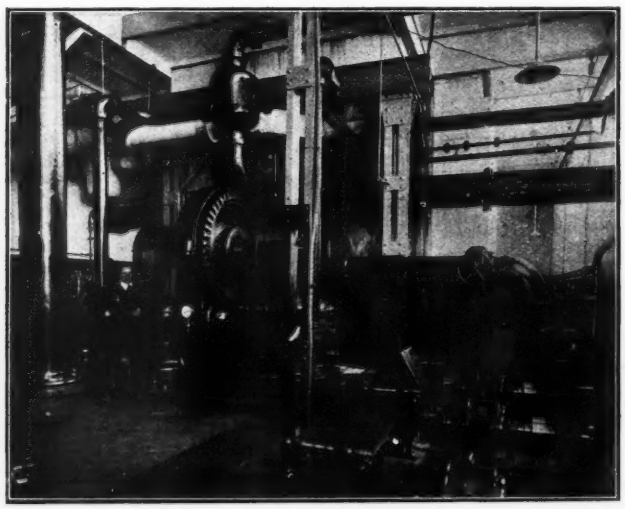
INTERIOR OF BOILER HOUSE.

The main part of the building which is to comprise five generator sets of 12,000 kilowatts each, will be erected at the Rosherville Dam. This artificial embankment, locked by a wall, has a capacity of 600 millions of gallons. The same central station is to contain, in addition to those five turbine-driven sets, four steam-driven turbo-compressors (under a pressure of nine atmospheres) of from 4,000 to 5,000 horsepower each. While the turbo-generator sets possess the largest dimensions of any ever constructed in Europe, these turbo-compressors are likewise the largest sets ever manufactured, the maximum output of any compressor so far constructed either for turbine or reciprocating-engine drive, being 1,500 horsepower.

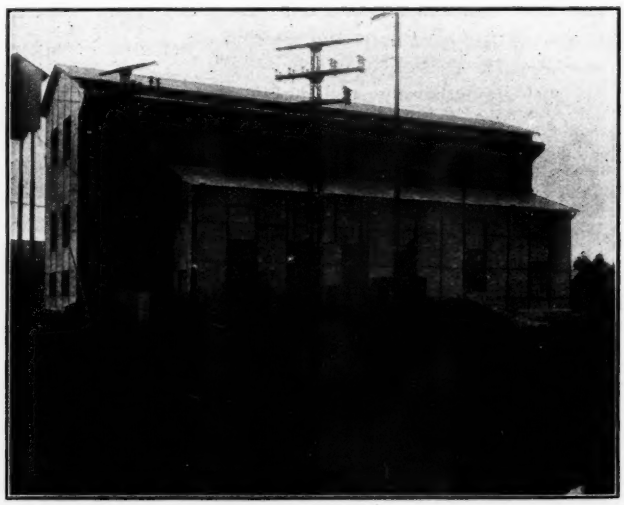
The second set of compressors, comprising six electrically driven units, is installed at a compressor station near Robertson Deep at about twenty kilometres distance from Rosherville Dam. This station at the same time serves as main transformer station. There will thus be three central stations, inclusive of those of Brakpan and Simmerpan on the embankment above mentioned, that of Simmerpan being extended by the addition of two machine sets.

Two further turbines, of 12,000 kilowatts each, are to be installed at some other place, presumably at Vereeniging, about fifty-five kilometers to the north of the Rand. Should present difficulties in obtaining the governmental authorization for the laying out of the overhead conductors not be overcome, these two machine sets would have to be installed at other points near the Rand. The total output of the machinery installed in those three central stations works out at about 175,000 horsepower.

The conductor system, starting from the three central stations, is being so arranged as to cover the whole of the Rand with a large network of high-tension lines, at 40,000 volts. The central part of the Rand is provided, in addition, with a cable system at 20,000 volts, fed partly from the Rosherville



CONDENSER PUMPS AT BRAKPAN CENTRAL STATION.



SWITCH HOUSE OF THE VICTORIA FALLS POWER PLANT.

power house, partly from the main substation at Robertson Deep, and being connected with the substations.

In the substations, the tension of the current is reduced to the working tension of the mines, that is, mainly to 2,000, and, to a smaller extent, to 500 volts. A total of thirty-two substations, varying in size between 1,000 and 6,000 kilowatts each, is being designed.

In the outside districts (to the west and east), the consumers' substations are fed by overhead conductors, mainly at a tension of 10,000 volts. All the conductor systems are provided with differential fuses, the overhead conductors being equipped with lightning arresters, consisting of three substantial steel wire ropes, suspended above the overhead conductors.

The design of the central station of Brakpan shows many departures from previous practice, the boilers, economizers and chimneys being combined into a single system. For each two boilers is provided an iron chimney, equipped with suction ejectors, which arrangement has given excellent results. The boilers have given in actual service a high efficiency in spite of the fact that coal of a low calorific value is used. Furthermore, the boilers are practically smokeless in working, the boiler room remains perfectly cool, and heat radiation is reduced to a minimum.

The switchgear is arranged in a special building independent of the central station, and is worked absolutely automatically, thus offering the advantage of allowing alterations and extensions to be made at any time, there being plenty of room on all sides.

The demand for current supply will be extremely high, contracts with the Eckstein Company alone covering 270 millions of kilowatt-hours, while an increase to 320 millions is anticipated. The demand of the gold fields will presumably reach fifty to sixty millions of kilowatt-hours, to which should be added a number of other consumers, so that a total initial consumption of 400 millions of kilowatt-hours will probably be attained.

To Send Money by Cable.

The British Post-office Department has concluded an agreement with the Western Union Telegraph Company, to become operative on January 1 next, whereby the company may make cable transfers of money to Great Britain and Ireland, where the orders will be honored through the postal department.

Electrical Exports for October.

The Bureau of Statistics of the Department of Commerce and Labor, Washington, D. C., has completed its monthly summary of exports and imports of the United States for the month of October. From this the following statistics relative to the electrical exports from this country during October are taken. As shown below the total is a trifle less than that of the preceding month, but much greater than that of the corresponding month a year ago. As compared with the conditions last year the exports of electrical machinery are still low, but their deficiency is more than made up by the increased exports of electrical appliances.

To give an idea of what the annual total will be as compared with the preceding years, the following figures giving the total electrical exports for the ten months ending with October in each case are of interest: 1907, $14,864,463; 1908, $10,655,052; 1909, $10,829,636.

The comparative monthly data are as follows:

	Oct., 1909.	Oct., 1908.	Sept., 1909.
Electrical Appliances	$ 683,819	$432,907	$ 686,049
Machinery	443,388	543,188	480,835
Total	$1,127,207	$976,095	$1,166,884

The principal countries to which electrical products were shipped from the United States during October, with the values of these exports, are as follows:

Exported to—	—Electrical— Appliances.	Machinery.
United Kingdom	$ 56,798	$ 33,521
Belgium	7,739	.....
France	9,277	12,976
Germany	5,388	1,844
Other European Nations	8,889	27,003
British North America	167,249	82,205
Central American States and British Honduras	13,903	13,892
Mexico	79,906	40,252
Cuba	38,884	6,876
Other West Indies and Bermuda	5,957	2,910
Argentina	19,441	22,755
Brazil	107,992	20,254
Other South American Countries	25,746	12,137
British East Indies	.....	15,471
Japan	15,614	73,220
British Australasia	28,879	40,350
Philippine Islands	79,686	3,849
British Africa	5,849	26,694

Arrangements for the Chicago Electrical Show.

But comparatively little unreserved space is now left for Chicago's fifth annual Electrical Show which is to be held in the Coliseum from January 15 to 29 next, the concerns having already made contracts including manufacturers and dealers from every section of the United States. To date there are more than one hundred exhibitors and it is estimated that twenty-five per cent more floor space will be sold this year than was disposed of at the 1909 show.

The feature of this year, from the novelty standpoint, will be the Wright aeroplane, which is to be placed upon exhibition by the War Department of the United States Government. The management of the exposition has had a special representative in Washington for several days in a successful campaign to secure this marvel, and it was through the personal request of President Taft that Secretary of War Dickinson authorized the display in the interest of areonautics and of electrical science. The government owns the Wright Brothers' patents and will send its only machine in charge of Lieutenant Foulois, the ranking signal officer, and a corps of signal men with complete wireless and telephone equipments. The government experts will make several interesting demonstrations and tests with the wireless outfits, sending and receiving from the aeroplane to and from stations throughout the Middle West and the vessels of the Navy Department in the lakes. The big aeroplane will be suspended from the center of the roof of the Coliseum against what are planned to be the most gorgeously beautiful decorations that have been created for any show building in the world.

There will be several interesting special days during the show in which the following organizations will feature: Wisconsin Electrical Association, Illuminating Engineering Society, Thomson-Houston Veterans' Association, Sons of Jove, American Institute of Electrical Engineers and the Chicago Electric Club. Other special days are being planned, and announcements will be made shortly.

In addition to space arrangements already concluded, contracts for space in the coming show were made during the last week with the following concerns: Allis-Chalmers Company, American Sign Company, G. M. Gest, Thompson Brothers Company, Hoover Suction Sweeper Company, Bishop & Babcock Company, Como Electrical Company, Collins Wireless Telephone Company, General Electric Company, Shelton Electric Company, W. W. Shaw Company, Chas. L. Kiewert Company, Enterprise Optical Manufacturing Company, Stromberg Electric Manufacturing Company, Electric Storage Battery Company, C. G. Everson & Co., Pacific Electric Heating Company and North Shore Electric Company.

CENTRALIZED LIGHT, HEAT AND POWER SERVICE IN A LARGE AUTOMOBILE WORKS.

PLANT OF THOMAS B. JEFFREY & COMPANY AT KENOSHA, WIS.

Probably no better indication of the enormous growth of the automobile manufacturing business can be given than comparisons of such factories of today with the same factories a few years ago.

In this respect undoubtedly one of the best examples which could be given is the factory of Thomas B. Jeffery & Company, Kenosha, Wis., manufacturers of the Rambler automobile, which, under the guidance of a single individual, can claim a growth of 700 per cent during the short period of eight years.

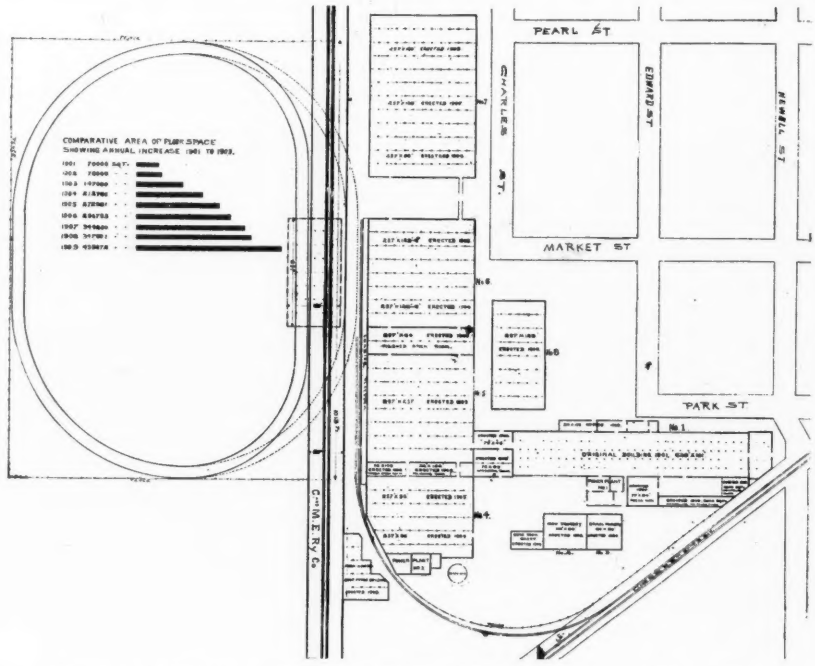
In 1901 Mr. Jeffery purchased, for the purpose of manufacturing automobiles, the factory building comprising the original Sterling Bicycle Company, covering an area of 70,000 square feet and located on the same site as the present Rambler Works. During 1902 an iron foundry, 100 feet by 80 feet was added. The following year an additional building covering approximately 257 feet square was constructed; and during the succeeding years, on account of the steadily increasing business, in addition to the firm's intention of manufacturing more details of its machines, buildings were added until the present floor space covered is 455,672 square feet, and already plans are being formulated for the further extension of the factory.

By referring to the accompanying plat, some idea of the general lay-out of these various buildings may be gained. The original factory, 633 feet by 101 feet, forms the base line of an L-shaped group, the more recent buildings, known as Nos. 4, 5, 6, 7 and 8, forming the vertical line. With the exception of the former, all buildings are of concrete construction with saw-tooth roofs of sheet iron and glass. Much attention has been given to the natural illumination, there being innumerable windows in addition to the glass roofs already mentioned.

While the foregoing brief outline of the rapid growth of this Kenosha factory is in itself interesting, a study of the development of the methods of transmitting power, of lighting and of heating, as evidenced by the changes from belt transmission to rope drives and finally to the complete substitution of electric transmission, used in connection with the various stages of the growth of this factory presents some unique and interesting features.

Referring again to the plat, the power plant for the original factory may be seen adjoining it at the center on the south side. The building is approximately seventy-five feet square, and its equipment consisted of four seventy-five-horsepower tubular hand-fired boilers, and a 300-horsepower Reynolds Corliss engine. This engine transmitted power by means of belts to the various shafts and countershafts, which, in turn, were belted to the individual machines. A small generator was included in this equipment which supplied current for the open arc lamps used for general illuminating purposes and the incandescent carbon lamps for individual machine lighting. The heating system comprised blast fans with galvanized-iron air ducts. With the addition of the iron foundry in 1902 directly in the rear of the power plant, the problem of transmitting power to this building was solved by means of rope transmission from the same engine through the intervening space to the main shaft of the foundry.

With the addition of building No. 5, the first of the row of buildings running north and south, it was found necessary to install in the power plant a 100-kilowatt direct-current Western Electric generator. This machine was belt-driven by the same Corliss engine, and the current was transmitted through cables to the various departments of the new building. When building No. 4 was added, the capacity of this generator was too small to furnish the additional current required. Therefore, it was found necessary to erect a new power plant at the south end of the row of north and south buildings. In this plant were installed a 300-horsepower Allis-Chalmers Corliss engine and four 150-horsepower fire-tube boilers. This station was known as plant No. 2. The transmission of power to building No. 4 was accomplished by the installation of a rope transmission system, and the electrical load in building No. 5 originally carried by the generator in plant No. 1, was divided and half of the current was supplied by a 100-kilowatt six-pole Bullock generator installed in the new station. This generator was driven by the engine by means of an intricate rope transmission system.



PLAT OF THOMAS B. JEFFERY & COMPANY'S PLANT, KENOSHA, WIS.

The buildings constructed during the years of 1904 to 1907 were supplied with power by the Bullock generator which was later augmented by the addition of a ninety-kilowatt Crocker-Wheeler direct-current belt-driven generator. The lighting system of the new buildings was comprised of 250 enclosed arc lamps for the general illumination, and carbon incandescent lamps for individual machine lighting.

The introduction of additional machines and departments, such as up-

holstering and wood working, body department, wheel department, etc., together with brass and aluminum foundries in addition to the great distances to be covered, so far increased the load on the existing electrical mains as to necessitate either expensive additions or a change in the methods employed, which would suggest a third power plant located remote from plant No. 2. This, however, would bring in questions of coal supply, additional buildings, additional help and fire risk, which would necessarily be undesirable. It would also require additional expenditures for large copper mains in carrying out the low-tension direct current scheme.

After a thorough study of the situation, it was deemed advisable to change over to the alternating-current system with the provision that this would ultimately supersede the existing systems of transmission. It was also decided to install the necessary apparatus in the plant known as No. 2, changing over from the 110-volt direct-current system to a 480-volt three-phase system. To obviate the delays incidental to this change and to overcome the necessity of closing down any part of the shops while the change was being made, three new cables similar to those in service were installed, branching out from power plant No. 2 to building No. 7 on the north, and to buildings Nos. 2 and 3 on the east. The four existing cables were allowed to carry the load uninterrupted while the three additional cables were being supplied with a higher voltage. An induction motor of proper size and speed was placed alongside every existing direct-current motor and fitted with appropriate belt and pulley. One by one the direct-current motors were eliminated and the alternating-current machines connected in until the entire group were displaced and the load transferred from the old cables to the three new ones.

To change over the lighting system without disturbing the feeders and branch lines, the various sections were divided and connected to single-phase stepdown transformers. These were in turn connected to the three new alternating-current mains until all of the lighting circuits were disconnected from the old mains, leaving them idle.

Three of these old mains were then transferred from the direct-current machine to the alternating-current generator. The fourth main was then removed and used as one of the three additional lines connected with buildings Nos. 2 and 3 in which the same operations were repeated.

In this way the first three mains were used as power mains, while three of the four old mains were used for the 110-volt lighting circuits only, it being deemed advisable in a plant of this size to have the lighting and power current transmitted through separate mains.

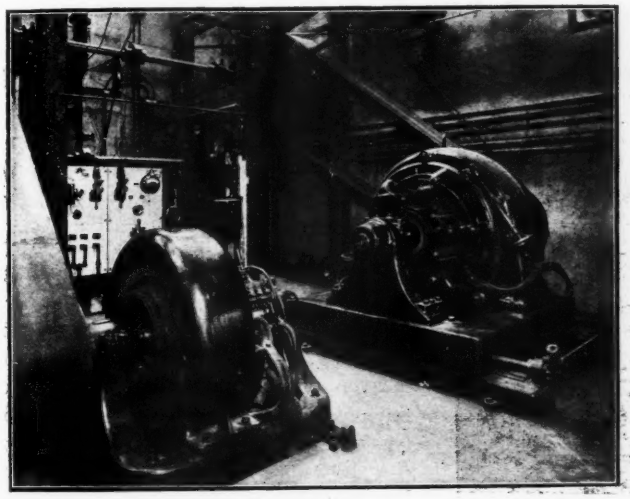
This development meant extensive changes in power plant No. 2, and when the new equipment was installed proper provision was made for the extension of the alternating-current system of transmission to accommodate the further developments which will necessarily take place.

The new unit installed consisted of a 375-kilowatt, 480-volt, three-phase, sixty-cycle General Electric alternator direct-connected to a 24 by 25 Fleming-Harrisburg four-valve engine. Both the engine and generator represent the best types of machines suitable for a station of this character, the former being the product of the Harrisburg Foundry and Machine Works, Harrisburg, Pa. The engine is self-oiling throughout and has a steam economy of twenty-three pounds per indicated horsepower per hour. A twelve-kilowatt, 125-volt, direct-current exciter is employed for this unit, mounted on the engine shaft.

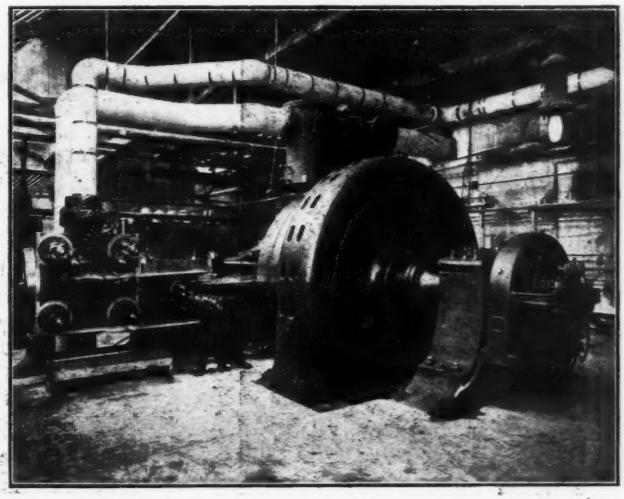
In connection with the increases and changes in the electrical department, steps have been taken to bring the steam-generating end up to a similar plane of efficiency, the magnitude of the plant being such as to render the coal shovel and low-pressure steam boilers obsolete. The first step in this direction has been taken in the installation of a 500-horsepower Stirling water-tube boiler equipped with a Green chain-grate mechanical stoker. This boiler is equipped with a steel smokestack 125 feet high and five feet in diameter. It is intended that every additional boiler installed will have an individual stack.

An efficient coal-handling system is now under construction wherein 1,500 tons of coal will be stored in overhead bins and automatically distributed to the boilers after having been conveyed from the cars by means of coal-conveying apparatus.

The new engine-room piping runs parallel to the old system and is so arranged that the new sections may gradually be substituted for the old ones without interfering with the operation of the plant.



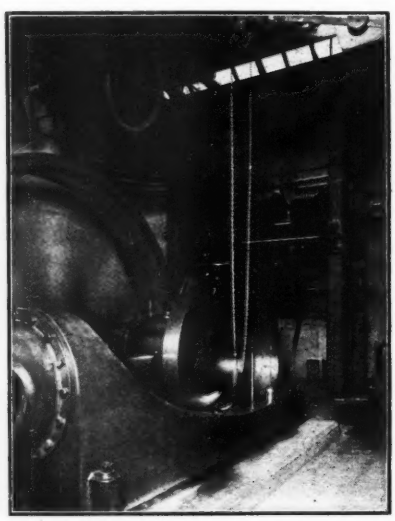
VIEW OF BELT-DRIVEN GENERATORS WHICH WILL BE REPLACED.



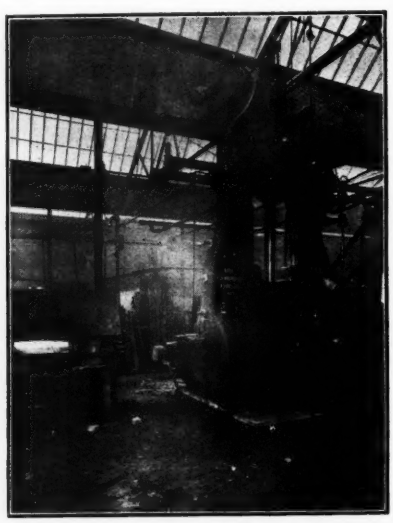
NEW ALTERNATOR DIRECT-CONNECTED TO FLEMING-HARRISBURG ENGINE.

The heating apparatus consists of overhead ceiling coils, using exhaust steam, and connected with a return system of vacuum pumps located in the engine room, the arrangements of the return system being such as to permit of the independent control of the temperature of each building by the engineer in the engine room. The temperature of the entire group is covered in this way. All of the returns are pumped back to the boilers. In this system of heating about 500,000 feet of one-and-one-quarter-inch piping is used, each coil comprising on the average about 1,500 feet.

In keeping with the developments throughout the factory, all of the direct-current arc lamps were replaced by 250-watt tungsten lamps with special reflectors, suspended, one in the center of each truss. A tungsten lamp was substituted for each arc lamp, all of the old circuits and cut-out boxes remaining the same. This system has so far proved very efficient, it being possible in many instances to eliminate the individual machine incandescent lamps.



VIEW OF OLD ROPE TRANSMISSION SYSTEM.



MOTOR-DRIVEN HAMMER IN OPERATION IN SHOP.

The motor system employed comprises various sizes of induction motors, the maximum rating being fifty horsepower each. It is the intention to employ no larger machines than these. All of the speeds and pulley diameters being fixed and the same, it is planned that when a given department can no longer be operated by a fifty-horsepower motor it will be divided into two departments and another motor installed. The second motor can be smaller if desired, and it in turn can be replaced by a larger one as the needs of the department demand. In this way a very flexible power system is provided for.

The weight of the fifty-horsepower induction motor, together with its slide-rails and base, being little over 2,000 pounds, it is very easily handled and it is also comparatively easy to remove the small motor that has become overloaded and replace it with the size larger in such a short period of time that the work of the departments will not be interrupted. The construction of the floors of the shops of cement readily permits of easy anchorage by means of expansion bolts, no other foundation being necessary, while the smallness of the motors permits of their being moved around on an ordinary factory truck. This plan also enables the load of all of the motors to be adjusted to a nicety and keeps the entire equipment in balance.

A similar method is employed with the transformers. The need of a flexible and easily changed method of increasing the power and lighting circuits is most valuable in the automobile manufacturing business where the expanding departments crowd each other, necessitating continued readjustments of power and lighting facilities.

In addition to the above mentioned equipment the entire factory is provided with a modern sprinkler system. With this and an organized fire department on the premises the fire risk is reduced to a minimum.

On account of the innumerable machines and the limited amount of space, the employment of individual motor-driven machines is almost impossible. However, the larger machines are all individually motor-driven, the motors being in some instances belt connected and in other instances direct connected to the machines which they operate. In one of the accompanying illustrations is shown a 300-ton press driven by a General Electric induction motor.

The construction of the plant, together with the details of the installation and maintenance of all power machinery has been under the direct supervision of John Erwood, mechanical engineer, Chicago, Ill., who, associated with Mr. Jeffery, has worked out a programme which provides for the ever increasing lighting, power and heating facilities. The wiring was done by Henry Newgard & Company, electrical contractors, Chicago, Ill. The Fleming-Harrisburg engine was installed for the Harrisburg Foundry and Machine Works by W. W. Bird under the supervision of A. M. Morse, Chicago, district manager of the company.

Another Suit Brought Against the Economy Power Dam.

On December 14 suit was entered in the United States Circuit Court at Chicago by United States District Attorney E. W. Sims, acting under instructions from Attorney General Wickersham, against the Economy Light and Power Company, of Joliet, Ill. The government asks that the company be enjoined not only from doing any further work on the construction of its dam at Dresden Heights on the Desplaines River, but also that the construction work already done be taken out, leaving the river in its original state. The federal attorneys contend that since the opening of the Chicago Drainage Canal the Desplaines River has been a navigable stream and is therefore under the jurisdiction of the Department of War. The contention also is that the company should have obtained a permit from the Secretary of War.

It will be remembered that a few weeks ago a similar suit brought on behalf of the State of Illinois was thrown out by the Supreme Court of that state, and it seemed that the company was therefore firmly intrenched in its projected power development at Dresden Heights.

It is believed that the advocates of the deep waterway from "The Lakes to the Gulf" have prevailed on the federal government that the Economy dam is a hindrance to this project.

December Meeting of the Electrical Engineering Society of Columbia University.

On December 10, J. W. Lieb, Jr., addressed the members of the Society on the general subject of "The Relations Between the Electrical Industry and the Public." Though the subject is a very broad one, Mr. Lieb's long connection with the lighting industry, especially as vice-president and general manager of the New York Edison Company, indicated that he was well qualified to cover the subject comprehensively, and this expectation was fully realized. Prof. G. F. Sever is to be congratulated upon his success in adding to the already long list of prominent men who have addressed the meetings.

Beginning with the problems of generation, Mr. Lieb called attention to the great increase in hydroelectric plants. He stated that the public clamor against soft coal usually included the indictment that it was used on account of being cheaper than hard coal, which was contrary to the facts, the preference being due to the greater ease of working.

He used many slides during the lecture, the first ones showing Waterside Stations No. 1 and No. 2. As an indication of the revolutionary development among genertaing units, the major part of the equipment of Waterside No. 1, which was installed in 1902, will very shortly have to be scrapped. These two stations are capable of delivering 180,000 kilowatts, which is almost equal to the present output from Niagara Falls. Charts were shown giving the distribution and the hourly, daily, weekly and monthly loads. The load factors in the private house district were about the same as those in the business district, namely, 42.5 and 41.3 per cent, but the hours of use did not coincide, thus creating a valuable diversity factor.

The immense electrical requirements of the Hudson-Fulton celebration were not matters of as great concern to the company as many of the public imagined, for the maximum demand on the station during the celebration was less than one-half of that of the maximum during the preceding December. In conclusion, charts were shown showing the great increase in lamp life and efficiencies now attainable.

Announcements of forthcoming lectures, which will be given by prominent men, will be announced shortly.

Another Plan for Third Avenue Railway.

A second plan of reorganization for the Third Avenue Railroad has been submitted by the Bondholders' Committee of that company to the Public Service Commission. This plan is more nearly in line with the position of the commission, although no reduction in the total securities of the Third Avenue property is contemplated. There are at present mortgages amounting to $58,460,000 on the Third Avenue properties, not counting the underlying issues. The report of the company for the year ending June 30, 1909, showed an amount of $1,300,000 remaining after paying interest on this amount.

The new plan of organization contemplates continuing the present first mortgage bonds and adding 15,799,000 first and refunding four per cent fifty-year bonds.

Metropolitan Lien Injunction.

Justice McLean, in the Supreme Court, has granted an injunction restraining New York City Collector of Assessments and Arrears Moynahan from selling the city's tax lien on the Metropolitan Street Railway Company. The court held that because of oversight, neglect or other official fault exorbitant sums are stated to be due for the taxes on the road between 1901 and 1907.

Justice McLean has also granted an injunction restraining New York city from selling its tax lien against the Second Avenue Railroad Company of New York.

Lecture on Storage Batteries.

An illustrated lecture on "The Care and Operation of 'Exide' Batteries in Electric Vehicles" was delivered in Washington Hall, Detroit, Mich., on December 9, by Bruce Ford, one of the engineers of the Electric Storage Battery Company, Philadelphia, Pa.

The lecture was given under the auspices of the Edison Illuminating Company, of Detroit.

Gyroscopic Balancing.

It is stated that Louis Brennan's master patent of 1903, which has been taken out in thirteen different countries, is so broad in its claims that it covers the use of gyroscopes to make any unstable body stable, whether on land, at sea, or in the air. Dr. Otto Schlick's gyroscope for use in ships to minimize rolling, is stated, on the other hand, to be a device to increase the natural period of oscillation of the ship so that the latter does not respond to the successive rocking efforts of the waves. From this it would appear that Mr. Brennan has a monopoly, which, if not so valuable as such basic patents as the Bell telephone, should at least be productve of considerable returns if sufficiently developed and exploited within the next few years in the fields of terrestrial locomotion and aerial and water navigation.

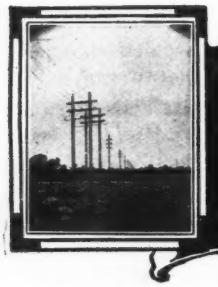
Cheap Yearly Rates for Electric Current.

According to the London Electrician, the Lighting Committee of the Borough of Hampstead, London, England, has been authorized to enter into agreements with occupiers on a basis of £8 5s 0d (about $41) per kilowatt per annum (payable in advance) for the maximum demand required for lighting houses throughout with electric light, and one (English) penny (two cents in American money) for all current supplied. This is to be done in order to encourage the use of electricity for heating and power in private houses.

Navy Department Supplies.

The Bureau of Supplies and Accounts, United States Navy Department, Washington, D. C., will open bids on the dates given below for the following equipment and supplies. Bidders should without delay make application to the Bureau for copies of schedules, being careful to give the schedule number. Copies can be obtained on application to the Navy Pay Office nearest each navy yard.

Date of Opening.	Material.	Quantity.	Delivery at Navy Yard.	Schedule No.
December 21, 1909...	Appliances, wiring	Miscellaneous	Norfolk, Va	2025
	Cells, storage battery	24	" "	2025
	Conduit and fittings	Miscellaneous	" "	2022
	Lamps, arc, direct current	25	" "	2025
	Lamps, flame and carbon arc	12	Brooklyn, N. Y.	2021
	Mica, uncut	100 pounds	" "	2022
	Panel, battery control	1	Norfolk, Va	2025
	Supplies, electrical	Miscellaneous	" "	2025
	Unions, conduit, brass	2,550	" "	2022
	Voltmeter and millivoltmeter	1 each	" "	2025
	Wire	Miscellaneous	" "	2021
	Wire and cable	"	" "	2025
	Wire, fireproof, solid	2,950 feet	" "	2021
	Wire, rubber-covered	28,000 feet	Brooklyn, N. Y.	2021
December 28, 1909...	Generators, 2 kilowatt	5	" "	2040
	Tape, rubber, insulating	2,000 pounds	" "	2045



CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

DEVELOPMENT OF ELECTRICAL UNDERTAKINGS.[1]—III.

BY S. J. WATSON.[2]

One of the greatest changes that has taken place in recent years has been in the extended usage of multiphase current, brought about principally through the necessity of generating and transmitting high-pressure currents which could be reduced to a lower pressure by means of static transformers and then used for power purposes.

As it has become the common practice to generate multiphase currents, it is somewhat remarkable that so little has been done in the distribution of such supply direct to consumers without conversion. A three-phase system of generation and distribution at high or extra high pressure to static transformers, and thence through a three or four-wire low-tension network to consumers, appears to offer the highest efficiency with a minimum cost for attendance and for capital outlay, and in the future I feel sure that progress along these lines will be recorded. On the other hand, without wishing to raise a heated discussion on the respective merits of direct versus alternating-current motors, there is no doubt that many manufacturers appreciate and have taken full advantage of the improved results obtained by using direct-current motors with efficient long-range speed-regulating devices, and would not have a constant-speed motor even if it was given to them. For other classes of work the alternating-current motor, with the speed depending on the periodicity and practically unaffected by changes of pressure or load, has undoubtedly given good results, but with the exception of the fine spinner and a few other special trades, and then only when they are always engaged in the production of materials of exactly the same kind, I am not altogether convinced that a direct-current motor with speed regulation will not be equally satisfactory. It naturally follows, I think, that what may be the best speed for a given machine, be it a lathe, a rolling mill, a spinning mule or frame, or a loom when in use on the particular class of work, will not be the best speed when in use for a different class of work, and, therefore, some range of speed is a very desirable thing to have. I have been led to this conclusion through remarks made to me recently by two different textile manufacturers in my town. Both of them installed a few direct-current motors with shunt regulators to drive a portion of their premises. These worked very well, and I was subsequently approached in regard to the driving the remainder of the mills. A question then arose as to whether they should continue to use the existing direct-current supply or wait a few months until alternating current is available. In each case, much to my surprise, on pointing out how much better it would be to use constant-speed alternating current motors with no brush or commutator troubles, I was told that they did not want constant speed, as they had found it exceedingly convenient to alter the speed slightly to suit the work they might happen to be engaged on, and in regard to commutator troubles, they had not experienced any, and so would not benefit by the change. Some amongst you have probably had experience exactly opposite to the above, but I am inclined to think that the failure of direct-current motors in many instances has been due to the fact that the supply was given from private plants, and probably had considerable variation in voltage with consequent variation in the speed of the motors, or that the motors were over-rated and varied widely in speed with changes in load. Where such a condition of affairs existed, obviously much better results would be obtained by using alternating-current supply from the public mains. Most supply undertakings having alternating-current generators naturally enough wish to sell their supply without conversion, and they may be inclined to overlook the advantages their customers might obtain if such supply was converted to direct current.

In regard to distributing and feeder-cable systems, it is extraordinary what little alteration in methods obtain today as compared with 1894. The only changes of importance to be chronicled are that vulcanized rubber insulated cables have ceased to be laid for underground work, and the same remarks must also be made concerning the various systems with bare copper conductors. Otherwise the practice today is almost identical with that of 1894. Cables were then laid solid in wood or iron troughs and filled up with bitumen or were drawn into stoneware conduits very much in the same way as they are today, and advocates for one system or the other were equally strong in their approbation or condemnation then as now, but I think that on the whole the tendency is more towards the use of cables having an insulated outer covering such as bitumen than a conducting covering such as lead. One important improvement has been carried out, as it is now common practice to divide up the distributing network into sections correspondingly roughly to each feeder, and to provide fuses for each set of distributors so that a fault or a short-circuit on one set of cables shall not interfere with the maintenance of the supply to the others.

Integrating meters both for direct and alternating current have been much improved in recent years both in accuracy over a long range, in the smallness of the starting current, and in general reliability. Considerable ingenuity has also been shown in the design of slot, two-rate, and time meters.

Although a great deal has been said and written at different times in regard

1 Chairman's address at opening meeting, Institution of Electrical Engineers, Manchester (Eng.) Section, October 22.

2 Borough Electrical Engineer, Bury, Eng.

Note.—The English money values have been changed in all cases to approximate American figures.

to the charges for electricity supply, I am tempted to say a few words on the matter. The fundamental groundwork on which the charges are based is very well known and need not here be referred to, but it is in the application of these principles that there exists so much difference of opinion. Some discrimination must be shown between the long and the short-hour user, between the large and the small consumer, between those using the supply intermittently and those using it continuously, between those who are prepared to use it for a short time after sunset, and those who will agree not to do so during this period, and so on. No tariff has yet been devised that will take into consideration all these different elements, nor would it appear possible to work out a tariff that will deal in a fair and comprehensive manner with the great diversity of conditions which must always prevail.

It is probably less difficult to ascertain the amount to be charged to individual consumers on account of the working expenses of the generating plant than to arrive at a fair figure for the cost of distribution. Apart from other factors, an appreciable difference in price should be quoted to a consumer who only necessitates an expenditure of $500 on mains as compared with another at a distance on whose behalf $25,000 has to be spent. The capital charges in the one case at ten per cent per annum will be $50, and in the other $2,500. If the revenue received from each consumer at the same price per unit is $25,000 a year, it is clear that one is being charged five per cent too much and the other five per cent too little for the services rendered.

Another point which is often lost sight of is that the cost of meter reading and repairs, office expenses in making out and collecting accounts, depends entirely on the number of consumers supplied or on the number of meters fixed, and is independent of the consumption of each consumer or on the amount of the annual account. Assuming that 500 consumers are supplied using between them 1,000,000 kilowatt-hours a year, and that the cost of the above items come to $2,500 a year, equal to $5 per consumer per annum, or an average cost of 0.24 of a cent per unit on the total consumption. If one additional large consumer is connected using another 1,000,000 units a year, which at a power rate of one cent per unit would give an income of rather more than $10,000 a year, the extra cost of the items mentioned will only be $5 per annum instead of another $2,500, and it would be grossly unfair to reduce the charges to the other 500 consumers by 0.12 of a cent per unit and to charge the large consumer 1.12 cents instead of one cent per unit when the actual cost of supplying him is only quite an insignificant sum. Moreover, the difference between the price of 1.12 cents and one cent per unit on the output supplied to the large consumer is twelve per cent, and represents in cash nearly $1,250 a year, surely no small matter in these days of competition.

I have only mentioned these two aspects of the problem to illustrate the difference which must be made in the charges as between one consumer and another if the business is to be carried out on sound commercial lines, and how unjustified is the contention so often put forward by those insufficiently acquainted with the subject that all consumers should be charged alike without taking into consideration all the circumstances of the case.

There is just one other point in connection with charges for power supply on which I should like to say a few words here in Manchester, the busy industrial center of Lancashire. When the question of power supply has been under discussion at engineering meetings in this and other districts, I have heard the remark made time after time, that if any great progress is to be made in the application of motor power supply from public mains, the price will have to be brought down to about 0.6 of a cent per unit, because that is the total inclusive price (usually stated as rather on the high side) it is costing large consumers to work their own plant. Well, gentlemen, figures speak for themselves, and if there is one fact more than another which stands out prominently in connection with the most of the supply undertakings in Lancashire it is in the tremendous growth in the demand for power supply during the last few years. At first only comparatively small users were connected with ten to twenty horsepower, then, with slight concessions in price, applications came in from those having fifty horsepower, and with further slight concessions in price from 100 horsepower, and so the demand has increased by leaps and bounds, until today there are quite a number of consumers connected with demands of 1,000 horsepower and upwards.

To demonstrate the many advantages incidental to electrical driving, it has doubtless been necessary for undertakings in some cases to enter into a contract to supply at 0.6 of a cent per unit, but I feel quite sure it is unnecessary to quote so low a figure nowadays. Many large manufacturing concerns have found it remunerative in the long run to purchase from outside sources at prices varying between one and one-half cents and one cent per unit, depending on the conditions; but, unfortunately, it is difficult to get those who have made the change to come forward and give facts and figures to show what electrical driving has done for them. We are mostly left to assume that they are entirely satisfied through the way motor installations are extended as the opportunity occurs. There is not the slightest doubt also that a price between one and one-half cents and one cent per kilowatt-hour is quite sufficient to enable the most of the larger undertakings to maintain and even improve their financial position, as their accounts show that with the access of the power load at these low prices the working expenses per unit have been very largely reduced and improved financial results attained. These prices are only intended to refer to mills or workshops using the supply during ordinary factory hours and where fuel can be obtained at about $2 per ton. For longer hours the price can be appreciably reduced. If the demand can be used twenty-four hours a day all the year round it would be possible to quote a works situated near the power station a price of 0.4 of a cent per unit, equal to an annual charge of $35 per kilowatt per annum. The load factor in such a case would, of course, be 100 per cent. As a better load factor than this cannot be obtained, the working expenses could not be further reduced, but a slightly lower price might still be quoted if a consumer was able to appreciably reduce or entirely cut out his consuming device during certain hours in the winter months as a portion of the capital charges on the generating plant would then be allocated elsewhere. It does not appear likely that many large consumers of this kind will be forthcoming in the immediate future, and if they do arrive there will be very keen competition on the part of supply undertakings to obtain their

custom, but an outlet for the supply under such conditions may eventually be found if investigation into one or another of the chemical or metallurgical processes are brought to a successful conclusion.

I have endeavored to show that progress has, indeed, been made by electrical supply undertakings during the past fifteen years, and to define some of the means whereby such progress has been possible. In this case it is, however, somewhat difficult to discriminate between the cause and the effect, but I consider that probably the most important influence has been the gradual reduction in the price of electrical plant and appliances. Large generators which cost $30 per kilowatt can now be obtained for $8. Motors which cost $600 can now be obtained for $150. It may, in fact, be said that the price of all standard electrical apparatus has been reduced fifty per cent to seventy-five per cent. The use of electricity has in consequence steadily grown in popularity, and with the increase in outputs supply authorities have also been able to grant large reductions in the price per unit.

The only matter for regret is that many of the old-established manufacturing concerns, who have contributed so largely to the success of the industry, have not themselves received the financial reward their services deserve. The difference between a successful and an unsuccessful business is, after all, only a question of the addition or deduction of a few per cent to or from the manufacturing cost of the article produced. The annual value of appliances made and sold in this country has immensely increased during recent years, but coincident with this there has been no improvement, but rather a falling off, in their financial position.

In the earlier years of any industry changes and improvement take place at more frequent intervals of time than is subsequently the case, due in no small measure to the keenness and perseverance with which the young and vigorous brains and bodies of those always associated with new industries in the early days, are applied to the solving of the different problems as they arise. The electrical supply business will doubtless in time tend to remain stationary rather than to make further advancement. It does not appear possible, for instance, that manufacturers can reduce the cost of appliances by another fifty per cent or seventy-five per cent, or for the costs and charges of some of our larger supply undertakings to be reduced by a similar amount.

Cheap Electric Power from Coke-Oven Gas.

A dispatch from Big Stone Gap, Wise County, Va., states that this place will shortly be in a position to offer to the manufacturing world the very cheapest power to be obtained. The source of this power is coke-oven gas, a hitherto waste product of no value.

A short while ago a progressive coke operator in Wise County connected by a flue thirty-nine ovens and conducted this gas to his boilers, four in number, of 300-horsepower each, and from this gas as fuel, he is supplying power to run two 300-kilowatt, 1100-ampere generators, and a large compressor as well, at a cost which is slightly less than three mills per kilowatt-hour. This is on a small development of 1,000-horsepower. So satisfactory is this installation that he is now laying copper wire to the next plant, which he will supply with an electric current.

Big Stone Gap is the actual hub of the coalfields, and within a comparative short radius of the town there are 3,800 coke ovens and therefore there seems to be a possibility of an immense development in the future.

Hydroelectric Plant in an Old-World Village.

The village of Grassington, on the River Wharfe in Yorkshire, England, is one of the oldest "townships" in that part of the world, insomuch as it has a charter granted as long ago as the year 1286. In size, however, it is but a small village, having a population of about 500 people.

In spite of its small size and venerable antiquity, Grassington now possesses a modern electric-lighting plant, which was officially inaugurated a few weeks ago. The plant is hydroelectric and is of the simplest description throughout. The working head of water is eight feet, and a twenty-six-inch, vertical-shaft, water turbine is used to drive, through gearing, a twenty-kilowatt open-type, protected, continuous-current dynamo at 1,100 revolutions a minute. The supply pressure at the consumers' terminals is 230 volts.

The price for lighting is ten cents per kilowatt-hour, special rates and arrangements being made for power service whenever this may be required.

A Review of Electrical Development in England.[1]

Little advance has been made in the efficiency of the generating plant, and indeed there was little to expect with an existing efficiency of some ninety to ninety-three per cent. Large units have of course been constructed, and the form of generator modified to keep in touch with its prime mover.

Progress in the method of construction and improved quality of material have of course been added to the efficiency of modern machines. In high-speed machines the use of stalloy iron may increase the efficiency by one to two per cent, the use of ball bearings is also another improvement especially for increasing the efficiency of light loads. The use of interpoles on direct current machines is beneficial from the efficiency point of view, the losses in the commutator can be much reduced by the use of interpoles, though the losses in the interpoles themselves have to be remembered, and as the air gap can be much smaller than in machines without interpoles, hence smaller field losses occur in interpole machines than in other types of dynamo-electric machines.

In transformer construction the use of stalloy iron has reduced the no load losses by forty to fifty per cent without increasing the prime cost of the apparatus.

Vast improvements have been made in switchgear, the work being now more substantial necessarily owing to the use of heavy currents and higher voltages.

Considerable economies have been effected both by the use of simple devices and arrangements for the meeting of given service conditions, and also by the simplification of constructional details in individual pieces of apparatus.

The cost of oil switches and circuit breakers for most services has decreased without the loss of efficiency. An instance might be mentioned of the modern traction feeder circuit breaker, consisting of only a copper brush carrying an auxiliary metal and carbon contact, and pressed home onto two plain copper blocks by means of a simple toggle joint and handle. Compare this with the old arrangement of magnetic blow-out breaker, or an early design of carbon circuit breaker for the same service.

1 Abstracted from President W. M. Rogerson's inaugural address, "Electrical Power for Light and Tramways," to the Leeds Local Station of the Institution of Electrical Engineers, October 27, 1909.

Another instance is in the protection of a high-tension feeder circuit, where direct-acting trip coils are excited off instrument current transformers and given protection against overloads, with a time characteristic and discrimination against faults to earth, without the use of relays, dashpots, clockwork, auxiliary supply circuits and batteries, auxiliary trip coils to work with same, together with current transformers, which would have been supplied for the same service a few years ago.

Slate is commonly used now where it was once thought necessary to use marble with insulating bushes, and the recent reduction in the cost of aluminum is bringing this material into use in place of copper, now that satisfactory methods of working it have been evolved.

The enlightened application of electrical storage to the needs of a power station, whether direct or alternating current be generated is proving another fruitful source of saving in operating costs. While of course a load which can be economically dealt with by a generator should never be thrown on storage, yet there are in every generating station fitful and fluctuating demands that are unremunerative if supplied direct, in which case storage becomes a real boon, and properly proportioned as to capacity, may be made to contribute to revenue, so that the capital expenditure on the battery equipment, plus interest, upkeep, etc., are entirely redeemed in the course of a few years.

No great changes in the construction of accumulators have to be chronicled, yet present-day cells of reputed makers are in numerous respects an important advance due to careful development and improved methods of mounting.

Negative plates of the "box type," in which the active material is no longer expected to be partly self-supporting, retain their porosity and capacity much longer than the plate form.

By thorough screening of plates of opposite polarity by porous diaphragms, the tendency to buckling has been lessened, and there is no need to prospect for likely "shorts" with a battery stick between the electrodes, thus disturbing the active surface. Again, the avoidance of internal structures as far as possible (plates being now almost universally suspended in tension, instead of resting on bottom blocks) taken together with a liberal clearance for sediment, puts off by years the need of cleaning-out operations, and thus tends to increase the useful life of cells. Of course, weight should be the determinating factor in the purchase of a battery, other things being equal, prima facie, the more lead there is in the plates to begin with, the greater the life and the residual value at the end.

The revenue-earning capacities of a battery on the old-time method of floating batteries with cell regulators, charging batteries for hours and then allowing them to stand charged, inactive, waiting to be discharged, is not the most profitable way of using storage, and its real potentialities can only be brought by the automatic reversible booster. With modern practice, a quick-acting sensitive reversible booster controls the battery, and compels it to contribute its fair share of the work during the entire twenty-four hours of the day, and thus enables the boilers, engines and generators to be operated throughout at the point of highest efficiency. Efficient control, in fact, is the crux of storage battery engineering, as in this, far more than in the battery itself, depends the success or otherwise.

Another form of remunerative utilization of electric storage I can forsee, in the supply of current for lighting purposes and power, in districts served by electric tramways, but to which mains have not yet been extended. Of course, voltage variation at the nearest feeding point would cause the supply to be defective, if taken direct apart from interruptions, which are bound to occur from time to time; but the employment of a battery, together with a suitable booster and motor generator, would solve the problem satisfactorily, a relatively small battery sufficient to watch over the local circuit, when the breakers come out on traction, and after tramway service hours would suffice. There is, I think, much scope for the development of this class of supply, in the interests of undertakings owning combined stations.

Vulcanized rubber was largely used as an insulating material in early days, while pot drain pipes and cast-iron conduits were used for drawing into. Rubber insulation has, however, proved unsatisfactory, and to a large extent vulcanized bitumen and lead-sheathed paper cables have taken its place, either drawn into earthenware or iron conduits, or laid solid in pitch or bitumen in wood or iron troughs; the question of joint boxes and disconnecting pillars has also received consideration. Also the type of cable has to a large extent been changed, triple concentric and three-core taking the place of three singles, so diminishing the cost of the necessary protection, and minimizing the chance of electrolysis. The fear of electrolytic action in connection with lead covered cables has died out, as is evident by their almost universal use.

Another consideration has been the very greatly diminished cost of service connections, though there is no doubt room for great improvements in this direction still.

Meters will now start on a smaller current, are accurate on much smaller loads and give a straight curve up to full load and also with considerable overload; starting current is indeed of great importance with the introduction of the new metallic filament lamps.

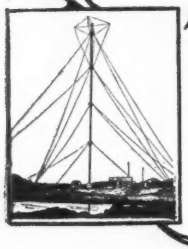
The introduction of this lamp has been the most remarkable event of late years, when it is considered that at least three times the light can be obtained with the same energy, its advent has been and will be severely felt by supply authorities, and although in time losses will be made good, yet it has to be remembered that additional capital will have to be laid down in the shape of service connections to obtain the same revenue, so that it is imperative that energy in another form, as for heating and cooking, will have to be used, if we are to maintain our revenue from the private consumer.

Waterpower in Europe.

According to Herr Koehn, says *The Electrical Engineer*, of London, England, the available hydraulic power of Europe is distributed as follows: Austria, 6,460,000 horsepower; France, 5,857,000; Germany, 1,425,900; Great Britain, 965,000; Italy, 5,500,000; Norway, 7,500,000; Sweden, 6,750,000; Switzerland, 1,500,000. Russia and the Balkan States, which are among the districts left out of the above list, also possess great possibilities.

A Novel Use for Electricity.

A curious patent has recently been issued to a German inventor. This is for a device for milking cows, in which the flow of milk is to be promoted by subjecting the animal to a "slight electric shock." While reserving comment on the humanity side of the question, it would be interesting to note what attitude the cow herself would take toward the operator of such a device.



TELEGRAPHY—TELEPHONY, and WIRELESS.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION.

REPORT OF CONVENTION SESSIONS ON DECEMBER 8 AND 9.

As was already reported in these columns in the previous issue the annual meeting of the International Independent Telephone Association was held on December 7, 8 and 9 in the Auditorium Hotel, Chicago, Ill. An account of the first day's meeting of the convention was given in the last number. A summary of the proceedings of the second and third days will be found below.

Owing to the temporary absence of the president, the Hon. E. H. Moulton, Minneapolis, Minn., and the vice-president, P. C. Holdoegel, Rockwell City, Iowa, the second session, opened Wednesday morning, was presided over by the Hon. E. B. Fisher, of Grand Rapids, Mich., second vice-president.

After the opening of the meeting, F. T. Dagger, of Ontario, Can., presented a very interesting paper on the subject, "Is the Telephone a Natural Monopoly?" dealing with the conditions which tend to establish monopolies not only in the telephone business. but in any industrial operation. No reasons, he stated, could be given and properly supported, that the telephone or any other business was naturally a monopoly. After the twenty years of monopoly in the telephone business which preceded the expiration of the Bell telephones, there were approximately one-quarter of a million telephones scattered throughout the United States, while at the expiration of twelve years of competition this number was increased to nearly seven million. Similar conditions prevailed in Sweden, where, after the sale of the Bell companies, and after some years of competition between the government company and the independent company, there was an average in Stockholm of 230 telephones to each thousand inhabitants. In direct contrast to this is the city of Chicago, in which there has been for thirty years undisputed monopoly, there is an average of only seventy telephones to a thousand inhabitants.

The Telephone Fire Insurance Exchange was the subject of a paper read by J. B. Hoge, Cleveland, Ohio, in which he spoke of the necessity of carrying company insurance on the telephone exchange and properties. The Telephone Fire Insurance Exchange operates in much the same way as the Mutual Life and Fire Insurance Company. Inspectors are employed to look over the equipment of the plants, and the company not only insures the building in which the exchange is located, but the entire system. That the company is in good condition financially may be seen from the fact that less than sixty-five per cent of the contingent fund is necessary to pay all losses and expenses.

Frank H. Woods, in dealing with "The Proposed Changes in the Association," said that he felt the need of steps toward a better organization, and commended the association on the work that had already been done toward such an end. Feeling the need of a better and closer organization, a committee, of which Mr. Woods was chairman, presented a report on amendments. One of the important things brought up for consideration was the change of name of the association from "International Independent Telephone Association" to "National Independent Telephone Association," as the Canada section has already formed an independent organization. Although the election of president has always been carried out in the past by popular vote on the last day of the convention, this was found to be unsatisfactory, and a motion was brought for the election of fifteen delegates to elect a president. Motion was also brought to assess each member of the association five cents per unit on their telephone exchanges, the money to be used in carrying out the work for the next year. The motion for the adoption of all of these amendments was unanimously carried.

H. L. Gary in speaking of the laws governing telephone companies urged the framing of such contracts with the association that even should the holders of telephone stock sell to the Bell company, or any other monopoly, the stock of the sale should be subject to the National Independent Telephone Association, and could not conect with the Bell company's lines. He mentioned a few companies, including the Des Moines telephone system which could have been saved from the Bell company by such contracts. He also urged strongly against the use of dual connections, stating that if they were not supplied they would not be demanded by telephone users.

C. B. Cheadle in discussion referred to the decision of the United States courts against all combinations which had been involved in legal proceedings. H. T. Critchfield, of Chicago, added that of the calls his company had received eighty-three per cent were in Illinois, and eighty-nine per cent were within the two states of Illinois and Indiana. He stated further that in two-thirds of the county seats no real competition with the Bell company had ever existed. A decided sensation was created by Mr. Critchfield's announcement that contracts have already been signed insuring the carrying out of an independent telephone system in competition with the Bell system in the city of Chicago between now and the end of the year 1910. Contracts for the carrying out of this project have been underwritten and signed by men of undoubted business ability, and contracts for connections have also been made.

The afternoon session of the Technical and Operating Conference was opened by a paper on "Office Accessories" presented by John W. Coffey, secretary of the Independent Traffic Association, Indianapolis, Ind. This seems to have been a much neglected side of the equipment of many telephone companies, and he demonstrated by many examples how improved methods of letter filing and account keeping would increase the income of nearly any tele-

phone company. After a short discussion of this paper the meeting was turned over to the officers of the convention, who reported the names of the seventeen directors entrusted with the management of the association and the election of a president. The directors elected were: E. H. Moulton, Minneapolis, Minn.; Theodore Gary, Macon, Mo.; S. W. Harper, Wheeling, W. Va.; Walter J. Uhl, Logansport, Ind.; Manford Savage, Champaign, Ill.; E. F. Day, Council Bluffs, Ia.; Wm. A. Jackson, Detroit, Mich.; Walter E. Doolittle, Lafayette, Ind.; A. E. Boqua, Ft. Smith, Ark.; Frank H. Woods, Lincoln, Neb.; E. B. Fisher, Grand Rapids, Mich.; O. C. Snider, Kansas City, Mo.; Charles West, Harrisburg, Pa.; S. A. Ward, Mansfield, O.; H. D. Critchfield, Chicago, Ill.; Max Koehler, St. Louis, Mo., and Richard Valentine, Janesville, Wis.

The conference was then continued with the paper on "Practical Methods to Handle Increased Volume of Toll Business" by W. S. Vivian, secretary of the Michigan Telephone Traffic Association. Mr. Vivian gave an account of his work in systematizing the phrases and methods of the central offices of the independent companies in Michigan. He dwelt particularly on the value of using certain definite phrases in establishing long-distance telephone connections. This is a direct revolution against the old method, which directs that the operator shall get a message through and "get it through anyhow."

Max W. Zabel, Chicago, treated the subject of "Patents—Uses and Abuses," especially as it applied to the telephone manufacturing industry. He pointed out several errors in the methods of taking testimony in patent cases and in the complicated and almost endless methods of litigation now in use.

The convention passed again to the subject of economic operating, or the paper on "Some Economic Problems in Telephony" by J. P. Boylan, Cleveland, Ohio. Speaking of the difficulty of obtaining experienced operators, he raised the question as to whether it would not be more economical for each company to train its own operators rather than to try to secure experienced girls. At the schools in Louisville, Ky., and Detroit, Mich., the operators are trained at an exceedingly small expense, and with excellent results. The meeting was then adjourned to resume the following morning.

The annual banquet given Wednesday evening was a great success, and in spite of the fact that the president, Hon. E. H. Moulton, and secretary, A. C. Davis, were unavoidably absent, proceedings went on with the joy of good fellowship so necessary to such events.

Hon. Mat. G. Reynolds, St. Louis, Mo., responded to a toast "Truth is the Daughter of Time," and encouraged the spirit of loyalty which brings men engaged in the same business and fighting the same battle together for conference and discussion.

Manford Savage, Champaign, Ill., speaking of "The Emblem," remarked that the Bell company had up to a short time ago regarded the independent as "goats which jumped into an enclosure containing sheep adorned with the blue bell of the Bell company."

In the "Live Wire," a toast responded to by Hon. W. B. Pedigo, Parkersburg, W. Va., a brief outline was given of the development of the independent companies, and showed how their precept of "the public be damned" had been to their great disadvantage. He concluded with the wish that the independents might always give the greatest good to the greatest number.

N. G. Hunter, Wabash, Ind., was one of the first independent telephone men and his reasons on the subject "Why Independent Telephones Should be Supported" were full of the logic given by

MEMBERS OF THE INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION AT THEIR BANQUET IN THE AUDITORIUM HOTEL, CHICAGO, ILL., DECEMBER 8, 1909.

years of hard fighting. "It is public opinion," he said, "that has raised the independent telephone companies to their present position, and so long as public opinion is on their side they will hold this position." He spoke for close organization and for permanency, discrediting any tendency towards monopoly.

D. M. Neil, Red Wing, Minn., told of the difficulties the Bell Telephone Company had met with and were meeting with in Minnesota. They have for some years, through laws which have been passed, been unable to declare any dividends, and are at present unable to pay their debts. In this State at least are the independent companies triumphant.

H. D. Critchfield was called upon for an impromptu talk, and responded by telling of some of the methods used by the Bell company for fighting their competitors. He stated that there could be no doubt of the success of the independent companies if they continued to support the public as the public has supported them. Such co-operation cannot fail to improve the association, which is even now in better condition than it has ever been before.

The Thursday Technical and Operating Conference was opened by Gansey R. Johnson, chairman, who, in the absence of H. E. Davis of Topeka, Kans., read his paper on "Operators; Answering Jacks; Maintenance." After a short discussion of this the meeting was continued by a paper on "Why Good Construction Reduces Depreciation" read by C. H. Judson, Seattle, Wash. The company represented by Mr. Judson has met with unqualified success in enforcing the installation of pay-telephones in drug stores and public places. The installation of these telephones had a deterrent effect on useless conversations, and considerable increase in the revenue of the company. There are at present no free telephones in Seattle with the exception of those of the Bell company, and even when one of the independent telephones is installed in the same store and even beside a free Bell telephone, there has been a monthly income of as high as $30.00. The growth of Seattle is at present so rapid that in many cases it is impossible to promise installation to some subscribers before a period of six months. Even under these conditions people have waited for an independent telephone rather than to take the Bell.

Franklin H. Reed, editor of *Telephony*, in a paper on "Co-operation as a Factor in Development," dwelt on the necessity of exchange of useful ideas through the technical papers. When one man finds some new method of solution of a problem it is his duty to his fellows to make that known in some way, and there is no simpler way than writing an account of the difficulty to some technical paper. If each operator would do this and each operator would read the technical papers there would be no doubt of the value of such co-operation. In discussion Mr. Johnson stated that he had obtained excellent results by subscribing for several magazines and giving the desired articles to his employes. At the close of this discussion Hon. E. B. Fisher opened the convention proper, and, after reading a few resolutions which were unanimously carried, the matter of collecting money for the next year was taken up. Through a popular subscription the amount of $20,000 was collected, the Continental Telephone and Telegraph Company alone giving $10,000.

EXHIBITS AT THE CONVENTION.

As is customary, a fairly complete exhibit of the electrical industry was held by the leading electrical manufacturing companies of the country and these were only second in importance to the convention itself. A few of those which attracted the most attention are given below:

The American Automatic Telephone Company, Urbana, O., exhibited a full line of switchboards and instruments and also an assortment of telephones and parts for both the automatic and manually operated systems. This exhibit also contained a number of electric clocks, time stamps, etc.

The Automatic Electric Company, Chicago, Ill., showed a complete equipment of automatic telephones and telephone systems.

The American Electric Telephone Company, Chicago, Ill., exhibited their latest switchboards, telephones and parts.

The Corwin Telephone Company, Chicago, Ill., offered for inspection its interior telephones.

The Dean Electric Company, Elyria, O., included in its exhibit, telephone switchboards, harmonic ringers and a full line of apparatus.

The Electric Appliance Company, Chicago, Ill., exhibited an assortment of Cracraft-Leich telephone equipment and a general line of supplies.

The Ericsson Telephone Manufacturing Company, Buffalo, N. Y., showed telephones, switchboards and parts.

The Holtzer-Cabot Electric Company, Chicago, Ill., exhibited a motor-generator set in operation, watchmen's clocks and a completely inclosed, waterproof mine telephone.

The Kellogg Switchboard and Supply Company, Chicago, Ill., showed some of their latest boards and a complete exhibit of telephones and supply parts.

The North Electric Company, Cleveland, Ohio, presented its auto-manual and manual switchboards, telephones and accessories.

Monarch Telephone Manufacturing Company, Chicago, Ill., exhibited switchboards, telephones, time service systems and supplies.

The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., showed telephone apparatus, aerial and underground cable.

The Swedish-American Telephone Company, Chicago, Ill., presented for inspection its telephones, switchboards and parts.

To Value Wire Lines.

Following closely after the recent reports of the merger of telegraph systems in the United States, a concurrent resolution was introduced last week in Congress by Representative Hitchcock of Nebraska directing the Secretary of Commerce and Labor to have the Bureau of Corporations prepare for Congress a statement of the physical valuation of the telegraph, telephone and cable lines and other tangible property belonging to the Western Union Telegraph Company, the Postal Telegraph and the American Telephone and Telegraph Companies.

The data will be complete to December 1, and is to embrace the subsidiary concerns, include the capital stock and the bonded debt of each of the three corporations and approximately the market value of the stock and bonds. The resolution authorizes the bureau to employ surveyors and appraisers for this work.

A Smoke Recorder.

An automatic smoke recorder, which has been placed on the market in this country, is attracting attention from cities where smoke ordinances are in force. The chart continuously shows the comparative blackness of the smoke at any time.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

ILLUMINATING ENGINEERING SOCIETY, OF GREAT BRITAIN.

INAUGURAL ADDRESS OF ITS FIRST PRESIDENT, PROF. S. P. THOMPSON.

On November 18 there was held the first regular meeting of the newly organized Illuminating Engineering Society, of Great Britain. The principal incidents relative to the formation of this British sister society to the American body of the same name have been chronicled in these columns at various times during the past year. The inaugural meeting was held at the quarters of the Royal Society of Arts, London, and the leading feature of the meeting was the presentation of the inaugural address of Prof. Silvanus P. Thompson, the first president. An excellent abstract of this address was given in *The Electrician*, London, November 26, and from this the following is taken:

In these days when so many associations exist for the diffusion of knowledge the foundation of any new society is a proceeding of questionable expediency unless it can justify its claim to existence. Its founders must be prepared to show that there has arisen some new science or else that in the organization of the sciences there has occurred some real need which existing societies fail to meet. Those who have founded the Illuminating Engineering Society have no hesitation whatever in putting forward the claim to justification on both these grounds. This society has, in fact, been founded to bring together all those who are interested in the problems of the art of directing and adapting light to the use and convenience of man. Their diverse and individual interests center around a common topic which, in default of a more appropriate name, is known as "illuminating engineering."

To advance the subject of illuminating engineering; to investigate the facts within its domain; to increase and diffuse knowledge respecting them; and to unite those who are devoting their energies to those things are the objects of the society. The ascertained facts are few; their significance is immense; their economic and social value is great but the ignorance respecting them generally is colossal. The subject is too new; for practically a century only have there been any systematic means of illumination in use and it is only within the last few years that the present position has been reached in a few enormous strides.

Foremost in the work of the society there must stand the question of units of measurement and the promulgation of proper definitions concerning them. Agreement as to what shall be taken as the unit of light and what as the unit of illumination at a surface must be secured. The former appears to be settled by the recent adoption of the international candle, but about the unit of illumination there is still some disagreement, both the lux and candle-foot being used. Adopting the latter for present purposes, all authorities are agreed that for reading at night not less than one candle-foot is required. Reading is impossible with an illumination of less than one-tenth candle-foot, difficult and fatiguing with one-fifth candle-foot, comfortable with from one and one-half to three or four candle-feet and dazzling if the illumination exceeds six or eight candle-feet. Very seldom does the artificial illumination exceed three candle-feet, though in a room receiving direct sunlight four or five candle-feet may be attained.

No one can have worked at the photometry of modern lamps without becoming conscious of how much misunderstanding there is of the elementary laws of illumination. The inverse square law is often misapplied, being used in calculations of illuminations from sources other than points.

One of the things that ought to be undertaken by the Illuminating Engineering Society should be the formation of technical committees charged with the duty of preparing reports on different branches of the subject. One such subject on which information is badly needed is the specific brightness of surfaces of different kinds when subjected to a standard illumination. The subject of diffuse reflection has indeed been partially investigated by Doctor Sumpner and Mr. Trotter, but about diffuse refraction little is known. Again, there are a number of semi-physiological problems which demand investigation and settlement. For instance, does the contraction of the pupil depend on the total amount of light entering the eye or on the intensity of the image on local patches of the retina. Why should a light of tenfold brilliancy not produce a sensation ten times as intense? And why should a greater brightness of general surroundings relieve us of the annoyance of those colored after-images? After-images can be seen even under extremely feeble illumination. Has anyone discovered any exact law governing their occurrence?

There are even more important questions before the society, for now that we have a standard of illumination and simple portable instruments that will measure it, there can be no excuse for inaction or ignorance in applying that knowledge to securing proper illumination of schools and buildings. The former is most important, for whatever bad results flow from bad lighting of churches, factories or railway stations, those which result from the bad illumination of schools are far more to be deplored—they imperil the eyesight of the next generation. All ophthalmogists agree that the cause which forces children into increasing short-sightedness is protracted poring over books under an insufficient illumination. The London County Council has begun reforms in this direction, and the next step should be to secure a systematic numerical measurement with a simple portable illumination photometer of the actual conditions existing in the schools. Then the council will be able to instruct its surveyors

and architects as to what are the real requirements that ought to be fulfilled in the future. They ought to require an illumination of one and one-half candle-feet at the worst-lighted seat in the school-room. Another point in school lighting is the proper treatment of ceilings. In schools, as in all buildings, there must, moreover, not be over-illumination.

The lighting of factories is another matter requiring attention, for while the British Home Office issues regulations regarding the sanitary conditions in factories the lighting need only be "adequate." Holland appears to be the only country in which legislation has fixed a statutory amount of illumination, the figure there being from ten to fifteen candle-metres or 0.9 to 1.35 candle-feet.

Architects are often blamed for deficiencies in the lighting of the buildings they design; perhaps more often for the deficiencies found at night by artificial lighting than for those of the lighting by day. For this the fault rests, no doubt, largely with the persons who have installed the lighting arrangements. And one must not blame the architect too severely for having been as ignorant as all the rest of the world about the principles of illumination. But henceforward, when once it is known how much illumination is required in rooms of different kinds the architect ought, in his specification, to set down with appropriate numerical values, what degree of illumination is required in the various parts of his building. It would be a good thing if, in the public interest, the society could draw up a model specification for architects in which the proper way of presenting the requisite amounts of illumination, in different classes of cases should be set forth.

There is an immediate and direct function for the society to discharge in the collection, discussion and dissemination of knowledge; and in arousing the interest of the public and of public bodies to the economic and social importance of the questions for which the society is now united together.

The Interborough Rapid Transit Company, of New York city, has been ordered by the Public Service Commission to install sixteen-candlepower lamps in both the subway and elevated cars in place of the low-powered units heretofore used. It will cost about $25,000 to change all the lamps.

A NEW METHOD OF MEASURING LIGHT EFFICIENCY.[1]

BY C. C. HUTCHINS.

The measurement of light efficiency has been attended with unusual difficulties considering that what is required is merely the ratio of two numbers representing respectively the values of the visible and total radiation of the source. Nor do the difficulties arise merely from the necessity of comparing large things with small, but rather for the want of some method of properly separating the quantities to be compared.

To obtain a complete energy curve, and to compare the integral of the visible portion with the total is an extremely tedious and somewhat uncertain procedure. Angström's method requires an elaborate apparatus and the application of several troublesome corrections.

It is believed that the following method will be found as accurate, and much more simple and direct than those hitherto in use.

Theoretical.—Let the figure represent the energy curve of the light source; the vertical line separating the visible (a), from the infra-red (b). If now we define efficiency as the ratio of the visible to the total radiation, we have:

$$\text{efficiency} = \frac{a}{a+b}.$$

Let a water cell a few millimetres thick be placed in the path of the light. Assuming for the moment that the water is perfectly transparent to light, $a + c$ becomes the transmitted energy, the curve coming down to zero at wave length 1.8μ.

Further let a cell identical with the water cell, but containing a water solution opaque to light but transmitting more or less infra-red, be interposed, and let the transmitted energy be d. The transmission curve d must lie within the same narrow limits with c and the two areas be strictly comparable under like conditions.

If now we can measure $a + b$, $a + c$, d, and the ratio of c to d we have all that is required. For let

$$a + b = n$$
$$a + c = m$$
$$\frac{c}{d} = r$$

then
$$\frac{a}{a+b} = \frac{m-dr}{n}$$

Apparatus and Methods.—A thermopile consisting of a single junction at the focus of a small concave mirror set in a proper tube with diaphragms is pointed at the light and exposure made by moving a double wooden shutter. The deflection of the galvanometer is reduced by a known amount by putting resistance in the circuit. The deflection so obtained is proportional to n.

A water cell about five millimetres thick, having thin plate-glass walls, is then placed behind the shutter; the resistance is removed from the circuit, exposures made as before, and we obtain deflections proportional to m.

For obtaining d, a preliminary study of a large number of substances showed potassium permanganate to be quite suitable. It is very strong in color in solution, may be made opaque to sunlight in a thin layer, while transmitting a considerable amount of infra-red. A duplicate of the water cell is filled with a solution of permanganate of such strength as to just show the light under investigation, when held between the light and the eye. This cell being substituted for the water cell, we obtain a deflection proportional to d.

To find the ratio r. A spectroscope was given the following additions. A long slit was put in the place of the ordinary short one. The eye-piece was removed and replaced by an ebonite screen having a rectangular opening. One edge of the opening was cut to fit the curve of the spectrum lines in the red. The spectrum of the light source is focused upon the screen and the telescope adjusted so that the visible spectrum is just cut off by the curved edge. The infra-red alone now appears in the opening. In this position the telescope is firmly clamped.

Over the eye end of the telescope is now slipped a tube, having at its farther end a concave mirror and thermal junction. The mirror is large enough to receive the entire cone of rays coming through the screen, and condenses them upon the junction at its focus. This arrangement was used because it was at hand; a thermopile or bolometer, having a suitable receiving surface, placed immediately behind the screen, would be simpler. An image of the light source being thrown upon the slit of the spectroscope, the water and permanganate cells are placed alternately against the objective of the collimator;

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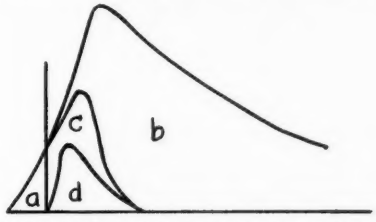
1 Abstracted from the *American Journal of Science*, December, 1909.

a shutter is moved as before, and the attached galvanometer gives deflections proportional to c and d respectively.

Remarks Upon Setting the Screen.—It has been customary in determinations of light efficiency to assume some definite limit to the visible spectrum, as 0.76 μ. Such a limit is quite useful for purposes of uniformity, that one man's work may be compared with another's, but only roughly corresponds to fact except in the case of sunlight. The limit of the spectrum is not the same for all lights or all eyes. It would therefore seem more logical to set the screen upon or near the limit of the red of the light under examination, although this will commonly give a smaller value for the efficiency than that obtained from 0.76 μ as a limit. This procedure seems further justified when we observe how steeply the energy curve rises at the limit of the red; so that a very slight movement of the screen upwards in the



CURVES OF VISIBLE AND INFRA-RED RADIANT ENERGY.

spectrum diminishes the apparent efficiency largely, while the actual light is diminished by an inappreciable amount. The smaller values therefore more nearly represent practical efficiencies.

Example of the Method.—The following measurements were made upon a portable acetylene lamp in which the gas was generated by automatically feeding granular carbide into water contained in the base of the lamp. The feed being intermittent, the light varied considerably but a fair average could be obtained by distributing the readings over a considerable time.

The resistance of the galvanometer and circuit was 2.203 ohms.

Through water the mean of five deflections was 202.2 millimetre divisions; through permanganate, 45.0 divisions. Ten ohms were added to the circuit, and the lamp direct gave 230.6 divisions, which when reduced to the scale of the others becomes 2531.

With the prismatic apparatus the mean of twenty readings through water with four ohms in circuit was 293.7. The resistance of the circuit was 2.203, and the deflection without added resistance reduced to 827.0.

The mean deflection through the permanganate cell was 205.8.

From these readings we have

$m = 202.2$ $\quad dr = 180.9$

$n = 2531.$ $\quad m - dr = 39.3$

$d = 45.00$ $\quad m - dr$

$r = 4.028$ $\quad \dfrac{m - dr}{n} = .0263$

This result is subject to a plus correction of thirteen per cent because of the loss of light to that amount in passing through the water cell. Applying this correction, we get .0296 for the light efficiency.

A second determination made after resetting the screen and changing the sensibility of the galvanometer gave .0323. The mean of the two is .0309 and the departure from the mean six per cent. The result may be considered very satisfactory considering the large change in apparent efficiency produced by a small displacement of the screen.

Saving the City Money.

Under this title the well-known American central-station expert, Glenn Marston, has written a striking article in *The Electrical Times* (London) November 11. As his argument is brief and to the point, it may be given practically in full:

"The tremendous advance made in illumination for advertising purposes has, in the past two years, had a unique effect on the cost of public lighting in the United States, and may account, to a great extent, for the fact that American lighting by local authorities is inferior to similar lighting here.

"The advertising load in American central stations is usually an important factor. In some districts mercantile associations have banded together and installed, at their members' expense, magnificent schemes of street lighting. Competition between cities is very keen, and it has been found that lavish lighting is one of the very best drawing cards for new population. It indicates an aggressive bid for trade, and at night draws people on to the streets in such numbers as to give an impression of exceeding liveliness.

"Competition between shops has brought window lighting to a very advanced stage, and the cheapness and effectiveness of electric signs has brought about a huge increase in this class of lighting. The result is that the average American business street has sufficient illumination to make public lighting unnecessary, except after the advertising lights have gone out, usually midnight.

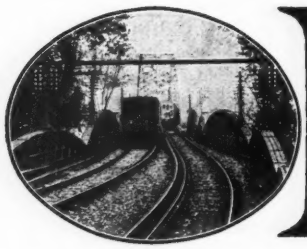
"Electric advertising has a pronounced police value. Cities once notorious for outlawry have become peaceful as country villages with the advent of extensive lighting. The mayor of Denver is the authority for the statement that the police force of that city would have to be doubled if the electric signs were removed. Since the civic economy of electric signs has been demonstrated, the rules for the erection of signs in Denver have been so framed as to encourage electric signs. The danger from frightened horses, which has been mentioned as a deterrent to sign erection in England, has never even been mentioned in America to my knowledge.

"Perhaps one of the best examples of economy in public lighting due to private illumination is in the city of New York. Broadway, as is well known, starts at the point of Manhattan Island, and runs nearly due north beyond the city limits."

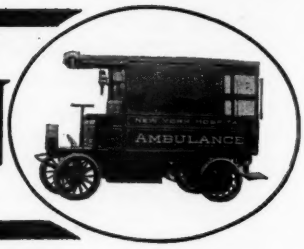
Mr. Marston shows two strikingly contrasted pictures, both taken along Broadway and quite familiar to metropolitan readers. One shows that portion of it above Thirty-fifth Street and the other shows the section above 135th Street, five miles further uptown. The former marks Broadway's path through the "Tenderloin," the other shows it where it has attained more sobriety and dignity, lined on either side with six and ten-story apartments.

"In the uptown picture are shown about forty public arc lamps, costing the city about $90 per year each, a total of about $3,600 to light properly this half-mile of New York's principal thoroughfare. Compare this with the downtown picture. There are only five public lamps between Thirty-fifth Street and Forty-second Street, yet this is the most brilliantly lighted half-mile in the world. The cost to the city is in the neighborhood of $450, a saving, on a half-mile of thoroughfare, of $3,150 per year. That saving represents aggressive and conscientious effort on the part of the electric company to better the street illumination.

"The energy of the company in thus saving money to the city is in no sense unselfish. It derives a far larger income from the downtown lighting. It is a brilliant example of the benefit a company may be to a community while working for its own best interests at the same time."



ELECTRIC TRACTION



Convention of the National Association of Railroad Commissioners.

During the convention of the National Association of Railroad Commissioners held recently in Washington, D. C., much of interest to electrical men was brought to the attention of the convention. Among the very important papers read was one by J. H. Smith, vice-president New York Central & Hudson River Railroad, on "Progressive Safety in Railroad Operation."

During the course of his remarks Mr. Smith touched upon the history of signal developments which grew out of the need of indicating the conditions of the road to trains and came with the increase in traffic and speed. As these conditions developed in England before they did here, the first steps were taken in that country. In 1834 the Liverpool & Manchester Railroad introduced the first system of fixed signals, consisting of an upright post with a rotating disk at its top, showing red for danger and the absence of indicating color by day and a white light at night indicated that the track was clear. This method was improved upon the opening of the Great Western Railway, when experiments by Messrs. Chappe, the inventors of optical telegraphy, showed that under certain conditions of illumination the color of any body would disappear. This demonstrated that the form and not the color of the day signal could be relied upon. It was also found that a long narrow surface could be seen further as projected against the horizon or landscape than the same area in a square or a circle. Making use of these results, Sir Charles Gregory, in 1841, designed and erected at New Cross the first semaphore signal. There was, at that time, no communication between stations, each signal man displayed his signal at danger after the passage of a train until a certain time had elapsed, when it was clear. The only information conveyed to the engineman was that the preceding train had passed at least the required length of time before.

The failure or inability to act with sufficient promptness at the display of the danger position and the consequent collisions, led to the installation of additional signals to give advanced information to the engineman by the position of the signal he was to obey. C. V. Walker, of the Southwestern Company, introduced the "Bell Code," which was the first audible method of communicating between signal stations. The same year Mr. Tyler supplemented this with electric visual signals, the object being to give the operator indication of the signal having been received and given, and at all times to show the exact position of the signal itself. This suggested the space interval between trains, in place of the time interval, making signal indications definite. In 1858 the positive block-signal system was established in England, based on the space-interval system.

Making use of telegraphic communication, Ashbel Welch, chief engineer of the United New Jersey Canal and Railroad Company, devised and installed during 1863 and 1864 the first block system of signals in this country, on the double track between Philadelphia and New Brunswick. Signal stations were suitably spaced, and at each station a signal was provided, visible as far as possible each way. The signal itself was a white board by day and a white light by night indicating "clear", shown through a glass aperture two feet in diameter in front of the block signal box. For the "danger" indication a red screen fell to cover the white board or light. On a train's passing a station the signalman released the screen, which fell by gravity, and did not raise it until advised by telegraph that the preceding train had passed the next station, thereby maintaining a space interval Thus was evolved the telegraph block system, still generally used, with modifications of apparatus and signals, on lines of light traffic. Elaborations of this system were later installed, following more closely the English practice, perhaps reaching the most complete development upon the New Haven and New York Central lines, where it is still in use. Notwithstanding the numerous improvements in apparatus, the same practice of fixing a positive space interval by means of communication between block stations still holds. The addition of track circuits for locking and indicating purposes and interlocking between stations, more fully effected by the introduction of the "Coleman block instrument," in 1896, has thus evolved the controlled manual block system as now used.

In 1867 Thomas S. Hall patented an electric signal and alarm bell, used in connection with a switch or drawbridge. Its shortcoming lay in the fact that a break in the circuit or failure in the battery gave no indication. To correct this, a closed circuit was necessary, though more expensive. In 1870 William Robinson devised the plan of having the circuit closed at the point of danger, if conditions were favorable, and opened a short distance in advance of the signal. The wheels of the approaching train depressed a lever, which closed the circuit and cleared the signal, unless interrupted at the point of danger. Subsequent modifications were made, whereby the circuit once completed remained so through the agency of an electro-magnet, and reopened when the train passed out of that portion of the track governed by the signal.

In 1871 Mr. Hall put into operation the first automatic electric block system on the New York & Harlem Railroad, between the Grand Central Station and Mott Haven Junction. It was normal "safety." The wheels of a passing train striking a lever completed a circuit, which put the signal to danger, after the train, and held it so until the succeeding signal indicated danger, when a separate circuit was completed, which released the former signal allowing it to return to clear.

The disadvantage in having the wheels of a train strike a lever to complete the circuit led F. L. Pope to experiment. After a successful attempt

in transmitting an electric circuit through an ordinary track with fish-plate joints, he made a signal test at East Cambridge, Mass. A section of track was insulated from the rest, with a wire circuit, including a battery and electro-magnet for operating the signal fastened to either end of the opposite rails. The metal wheels and axles completed the circuit, throwing the signal to danger against following trains. A detent served to keep the circuit closed until the next signal was reached, when a separate circuit released the detent, permitting the signal to clear.

In 1879 this system was put in service and, with some alterations, still remains in some localities.

Following the original manual semaphore and the controlled manual system of operation came the pneumatic and electric systems. For localities which required a great number of signal movements, with the development of motors and batteries capable of economic operation, automatic signals of the semaphore type have been successfully and widely installed.

On account of the wide-spread prevalence of electric lighting and the building up of the territory adjacent to railroads, changes in the color indications of night signals have been adopted, generally in such localities using green instead of white for the safety indication.

Developing with the manual operation of signals, and as a safeguard against mistakes of the signal men, interlocking grew up as a means for preventing conflicting signals being given at the same time. After a trip to England in 1869 Mr. Welch recommended the advantage derived from the English method of operating switches and signals in large yards and terminals, where the entire control fell to one man so located as to be in touch with the whole situation and equipped with a machine that would not permit of setting up conflicting routes. In 1900 an all-electric interlocking machine, advantageous where distant functions were to be embraced within the operation of the plant and applicable to localities where electric traction was in use was devised.

The more recent development of power-operated interlocking systems, with complete electric indications of the conditions on all tracks, has made it possible for larger systems to be consolidated under the control of a central plant, and thus under the direction of a central authority.

In train dispatching in this country the first radical departure from the time interval and flagging method of operation came in 1851. The New York & Erie Railroad established a single line of telegraph between Piermont, on the Hudson and Dunkirk, on Lake Erie, for company business in that year. Since that time the telegraph has been generally used for train dispatching.

Within the past few years experiments have been made with a system of train dispatching by telephone, now in successful operation upon some important lines, and growing in extent. Advantage lies in the ability to use trained railroad employees who cannot work under the telegraph system, not only insures a rapid distribution of information, but by its greater capacity enables a more complete knowledge of the state of the line to be had in the controlling office, as well as in all the offices tributary to the dispatching system.

In recapitulation he stated that from small beginnings there is in the world to-day about 100,000 miles of electrically operated roads; electric signalling and electric lighting and heating systems have also been introduced.

The committee on legislation also called attention in its report to the part that the commercial telegraph and telephone has in the business of the country and took the position that Congress should confer on the Interstate Commerce Commission the right to regulate their charges and supervise the service, requiring such improvements in and additions to the present service as business and the convenience of the country demand, including the necessary connection of telephone lines and the establishment of joint rates. State legislation should follow along the same lines. It suggester that general rules should be established either by direct law or order of commission, requiring railroads to provide means by telegraph or telephone, so as to furnish public information in regard to the time of arrival and departure of both freight and passenger trains.

The committee on safety appliances, in referring to the block-system of signalling stated that in the United States for the year ended December 30, 1908, there was an increase of 870 miles of road thus covered, and the increase was entirely in automatic-block signal mileage, the manual mileage being decreased during the year more than 500 miles. It is estimated that this increase would have been materially greater but for the fact that the railroads last year were passing through a period of depression. One significant feature of the matter is the increase in telephone operated mileage, the report of the block signal and train control board for last year showing that the telephone was used for block signalling purposes on January 1, 1909, on 2,357.2 miles more than on January 1, 1908. Referring to the questions which have been raised as to the comparative safety of the use of the telephone and telegraph in the movement of trains, some investigations were conducted by the board, and the result was that they reported that theoretically, telephones are as safe and as convenient as the long-used Morse telegraph, and the experience of many roads during the last two years has confirmed that theory. The only serious question that has every been raised regarding the safety of telephones is in regard to the liability of indistinct transmission of syllables and words, but that is a contingency that must be provided for in any telegraphic system, and with the telephone, as with the telegraph, mistakes are guarded against by good training and discipline and by repeating back all communications. As a matter of fact, the telephone is rapidly displacing the telegraph not only in block-signal work but in train dispatching as well. The question of safety seems to hinge almost entirely upon the personnel and methods in the operation of the apparatus.

The report of the committee on construction and operating expenses of electric railways was presented, which briefly outlined prevailing conditions and made several interesting recommendations.

The report outlines the system of accounts used in Wisconsin and New York and states that the committee did not intend to recommend the adoption or approval of any system, but does recommend that any state that is intending to adopt any system of accounts, in whole or in part, should adopt a plan which harmonizes or is in substantial agreement with the system in force under the jurisdiction of the Interstate Commerce Commission

and in the states of New York and Wisconsin. Doubtless changes will need to be made in these systems, but these can easily be made, provided the fundamental features of the system in actual operation are not departed from to any great degree.

The association will meet again in Washington next year.

A. F. T.

Indiana Railroad Commission Urges Work on Block Signals.

About seventy-five railroad men, summoned to a conference with the Indiana Railroad Commission on December 10, discussed at length the provisions of the recent law requiring them to install a block signal system on Indiana roads by January 1. A number of objections were raised to the electrically connected block signal because it presented, as the railroad men said, too many dangers of the apparatus getting out of order. The prevalence of opinion was that the manual block, not electrically connected, was the better, because it required for proper operation that the signal men be in perfect touch with one another, while this did no so greatly prevail in the electrically connected system.

It is the purpose of the Indiana Railroad Commission to remedy existing conditions and dangers but an elaborate system of signaling will not be demanded. The new law requires every road earning $7,500 a mile or more to install a system of block signals. There are a variety of systems and it is the purpose of the commission to enforce the installation of the system that is best suited to each individual road—the one which eliminates to the greatest extent the possibility of human error in their operation.

After a lengthy discussion as to the best system of block signaling, the commission agreed to extend the time for installation until July 1st, 1910, and in the meantime it will hold conferences with each road with a view of ordering the kind of block signaling best suited to each individual road.

Long-Distance Wireless Record.

According to R. Falck, of the Pacific Mail Steamship Company, the Korea, one of the vessels of that line, has succeeded in establishing a record by sending a wireless message to an American mainland station from a distance of 4,500 miles at sea.

Wires Over Railroads to Be Improved.

In a circular recently issued by the Indiana Railroad Commission to all telephone and telegraph companies in the state, it calls attention to the frequent accidents caused by the defective wiring of lines crossing steam and electric railway rights-of-way.

To guard against these accidents the commission recommends that in the future all telegraph, telephone, electric light, and all other wires of any kind, constructed over the tracks of any steam railroad within the state, shall be supported by good substantial wooden poles of a size not less than twelve inches in diameter at the bottom and not less than six inches in diameter at the top, or iron or steel poles not less than five inches in diameter at the bottom and three inches in diameter at the top, such poles to be set in the earth to a depth of not less than six feet and to be well tamped. All such wires shall clear the top of the rails of such steam railroad at least twenty-five feet, and shall be fastened to said poles in such manner as will properly hold the said wires in place. In the case of the trolley feed and other wires of any electric railroad extending over the tracks of any steam railroad, the height of such wires above the tops of the rails of such steam railroads shall not be less than twenty-two feet.

1,200-Volt Operation of Shore Line.

The first electric railway in the East to choose the 1,200-volt direct-current system is the Shore Line Electric Railway, running from Ivoryton to New Haven through Saybrook and Guilford, a distance of about fifty-two miles. After a careful investigation of the relative merits of both the 600-volt direct-current, the 1,200-volt direct-current and the single-phase alternating-current systems, the 1,200-volt system was adopted as being best suited to the operating conditions of this line.

The Shore Line Railway is being constructed and equipped in accordance with the most modern railway practice. A power station is located on the Connecticut River near Saybrook and will contain two 1,500-kilowatt twenty-five-cycle, 11,000-volt, three-phase Curtis steam turbo-generators with provisions for two additional units. Power will be transmitted to two stations, one located in the car house at Saybrook and the other at Guilford, each of which will contain three 200-kilowatt, 600-1,200-volt rotary converters. Two machines will be operated in series to supply current at 1,200 volts, and the third will be used as a spare, the switchboard being so arranged that any two of the three units may be operated together in any relation.

Twelve cars will be operated, each equipped with four G E-217 fifty horsepower 600-1,200 railway motors and Sprague-General Electric type M control. This equipment is arranged to operate on both 600 and 1,200 volts, the cars being provided with straight air brakes with CP-29 (twenty-five foot) 1,200-volt air compressors. The entire equipment of the road will be furnished by the General Electric Company.

It is expected that the road will be in operation the early part of next year. Although eleven roads have adopted the 1,200-volt system, the novel methods of construction in this instance will cause the operation of this road to be watched with much interest by railroad operators. As a very high-class service will be maintained and the reliability of service is considered of primary importance, the selection of the 1,200-volt direct-current system indicates the growing favor with which this system is meeting.

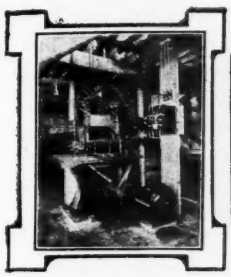
Maryland Trolley Lines Unite.

The Frederick Railroad Company, with a capitalization of $1,500,000, has been formed at Frederick, Md., by the consolidation of the Frederick & Middletown Railway Company, the Jefferson & Braddock Heights Railway Company and the Washington, Frederick & Gettysburg Railway Company, all Frederick County lines.

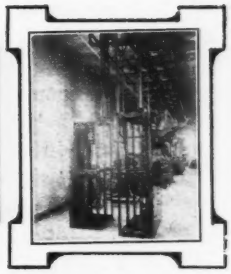
The new company will own about thirty-three miles of railway and will also operate the Myersville & Cateretin Railway Company's line between Middletown and Myersville, under a lease which was held by the Frederick & Middletown Railway Company.

Engineering Work Nearing Completion.

Engineering work for the projected interurban line of the Montana Rapid Transit Company, between Helena and Butte, Mont., is approaching completion. It is anticipated that contracts for construction will be let early in the spring. M. H. Gerry, Jr., chief engineer and general manager of the United Missouri River Power Company, Helena, Mont., is general manager of the new line.



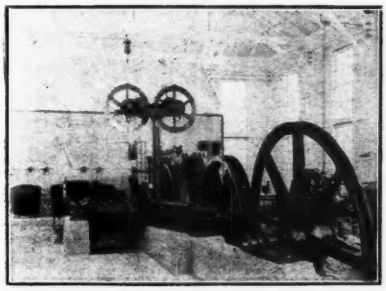
Industrial Power



MODERN APPLICATIONS OF ELECTRIC MOTORS TO MINE HOISTING.[1]

BY LEON M. HALL.[2]

Electricity is to the western miner what the automobile has been to his brother, the prospector, an almost indispensable adjunct in the exploration and development of the "Great American Desert." The applications of electric energy to the mining industry are so numerous and so varied that I shall not at this time attempt to go into detail, but will take up briefly one of the most difficult problems with which engineers have had to deal—namely, the application of the electric motor to mine hoisting.



BALANCED HOIST AT UNION SHAFT, VIRGINIA CITY.

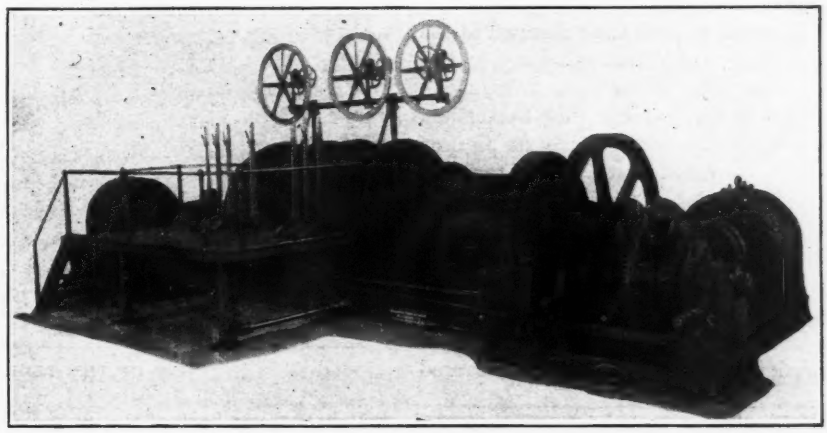
In the consideration of electrical hoisting engines, it might be appropriate to start with a brief discussion of the reasons and conditions which have facilitated the introduction of the electric drive into this immense and ever expanding field of electric application.

Hoisting, with its objectionable peak at the time of starting and acceleration, has always been a disturbing element in a transmission or distributing system, especially so where the hoists are large in proportion to the power-plant capacity or where they are located at the end of a long-distance transmission line. Many methods have been devised to overcome this peak feature, in order to secure a constant load factor, and with just what success I shall endeavor to set forth in the following.

About ten years ago electricity was introduced on the Comstock, and it was my good fortune to be entrusted with the task of applying it practically to the various operations, such as pumping, air compressing and hoisting. The first two worked out admirably, the last mentioned being the one problem that really offered serious obstacles.

The Comstock power contract with the electric company was at this time a very severe one, because it called for a $7.00 rate based upon a peak load of two minutes' duration. Furthermore, the initial generating plant, for all purposes, consisted of only two 750-kilowatt generators, water-wheel driven at the end of a thirty-five-mile transmission line, so that the introduction of electric motors of sufficient capacity to drive the then existing steam hoists was clearly out of the question; in fact, it became a serious question as to the practicability of using electricity at all for this purpose.

Up to this time, the variable-speed induction motor was still in the process of development and it really looked as though we would be compelled to resort to a continuously running induction motor equipped so that it could be connected to the reels by means of friction clutches (such a hoist was then in operation at Mercur in Utah), to use a direct-current generating set or to resort to the generation of compressed air and use it in the existing steam engines. The last mentioned was tried out, but the compressed air plants were entirely inadequate for the operation of the ponderous geared and first-motion hoists in use; in fact, there existed air capacity enough for only the actual mining operations. It meant, then, the installation of enormous compressors or an entire departure from any existing methods.



THREE-DRUM ELECTRIC WINDING PLANT WITH THREE-PHASE INDUCTION MOTORS AT MERCUR, UTAH.

About this time the mines along the Mother Lode were experimenting on lines laid down by C. O. Poole, and they finally succeeded in securing some excellent results by the use of compressed air reheated in the old boiler plants. Many of these installations are still in operation and this method has been carried on successfully in both Tonopah and Goldfield, notably in the Goldfield Consolidated, where they are working under a peak load of one minute.

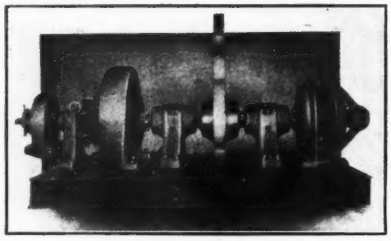
This method of applying electricity indirectly to hoisting operations has its advantages, particularly to the producer, inasmuch as the peak is eliminated and the load factor is nearly a constant one.

1 A paper presented at the Goldfield meeting of the American Mining Congress, September 27-October 2, 1909.

2 Consulting engineer, 814 Kohl Building, San Francisco, Cal.

and for properties operating under peak-load conditions it has the attractive feature of keeping the power bill within range of economical operation.

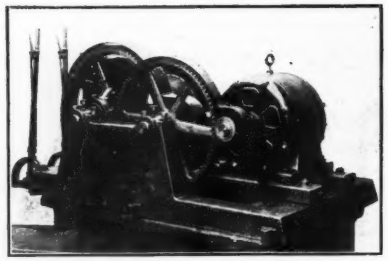
On the Comstock it was finally decided to install electric hoists equipped with the then new variable-speed induction motor. For installations under



MOTOR-GENERATOR FLYWHEEL SET AT KENDALL, MONT.

fifty horsepower, the motor was geared directly to the hoisting drums, but for operations requiring a greater capacity, I adopted a system similar to the Whiting system and known as the balanced-tail rope hoist. This, within the limits of its application and capacity, has proven an unqualified success.

To meet the conditions imposed in the contract by the electric company, and at the same time to maintain a high efficiency, it was evident that the motors should operate continuously at or near their full-load capacity, and, in the matter of control, be designed especially for the work to be performed. For a continuous full-load condition, the work must, of necessity, be constant, or nearly so, at all points in the lift, and the nearest possible approach to this was secured by the adoption of the balanced



ELECTRIC HOIST AT CRIPPLE CREEK (STANDARD IN 1900).

system, where the load is reduced to the weight of the rock alone. Then, to secure the necessary variations in speed, an induction motor with a non-inductive resistance in both primary and secondary was developed by the General Electric Company, the secondary resistance, and consequently the speed of hoisting, being varied by the introduction of a modified form of the ordinary street-car controller.

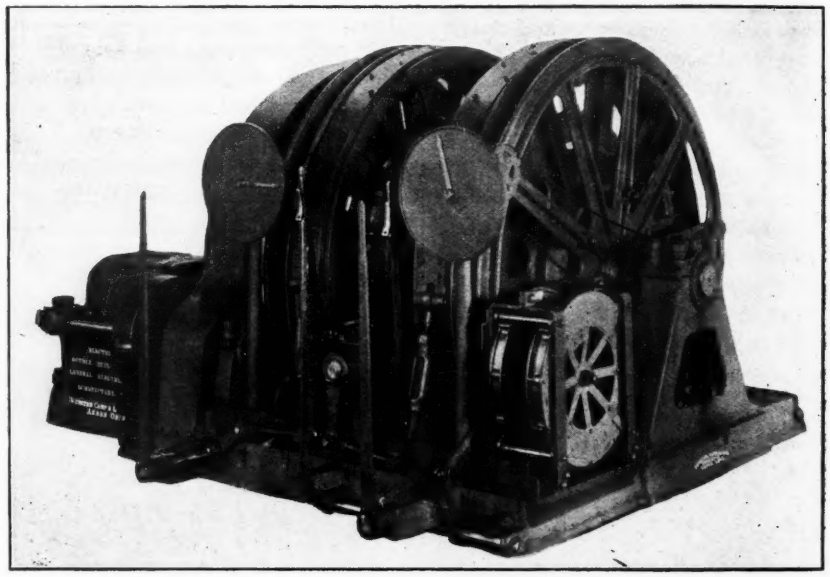
With an equipment of this kind the cages are started slowly and the dip in line voltage is comparatively slight, being about seven per cent at starting, and the time of acceleration eight seconds. By running on the second notch of the controller, one-third of the maximum speed may be maintained for the full length of the shaft without overheating or other serious results.

The hoist itself consists of a main driving drum and an idler around which the rope is wrapped four times, in order to secure the necessary friction for lifting. From the main driving drum, the rope is carried over the head sheaves, each end being attached to the top of a cage. The tail rope is fastened to the bottom of each cage and passes down one compartment under a movable tail sheave, and back of the second compartment to the bottom of the second cage. These hoists have been in continuous successful operation for about eight years, and while they are not adaptable for all conditions of mine hoisting, particularly where many different levels are to be accommodated, they have shown remarkable results in the economy of operation and the cost of power.

For instance, the hoist at the Yellow Jacket, lifting from the 1,200-foot level has, with a seventy-five-horsepower motor, raised 200 tons of ore in less than nine hours. The hoist at the Union Shaft, geared to a 100-horsepower, General Electric, variable-speed, induction motor, is hoisting from the 2,000-foot level at the rate of 1,250 feet a minute, and, during five years' service, has not cost one cent for repairs. The load being balanced, except for the actual rock lifted, the starting torque is low and the surge on the line almost negligible.

To my mind. this system can be varied to suit almost any condition, but, in order to secure the best results, it rests with the engineer to study thoroughly the individual hoisting-engine proposition and to adopt whatever is best suited to meet these conditions.

Where the alternating current is the source of supply, as is almost invariably the case, the most successful and practical method of application to hoisting conditions is through the motor-generator flywheel set. This method is by no means new, but is practically so as applied to mine hoisting on this continent, and, for this reason, the method has not received the consideration that is really due.



ONE OF THE OLDER TYPES OF ELECTRIC HOIST.

For its own protection, in preventing disturbances on its system, a power-producing company must naturally establish a limit beyond which an ordinary induction hoist motor will not be permitted on its circuits. For the heavier hoisting conditions, which are getting heavier with time as the shafts become deeper and the hoisting speed consequently increased, the motor-generator flywheel system adapts itself admirably. While the first cost of such a plant is comparatively high on account of the number of machines employed, economy and perfect control are compensating features, the former more particularly where the operation is semicontinuous.

A hoisting equipment of this character is made up of a shunt-wound, direct-current motor so arranged that it may be geared to any form of hoisting drums or reels, this motor to receive its power from a motor-generator set driven from the main power system. Such a set con-

sists of an induction motor and direct-current generator, with a flywheel swung between them, and a direct-current exciter unit overhung at one end of the set. The function of this latter machine is to excite the field of the generator and that of the direct-current hoist motor. The speed and direction of rotation of the hoist motor are controlled by varying the field strength of the direct-current generator by means of a rheostatic controller which is conveniently located for the hoist operator.

The induction motor is a variable speed machine. while the direct-current generator is provided with commutating poles and operates with a weak field at all loads. The flywheel is a machined steel casting and is perfectly balanced—so much so that these sets have been known to spin for over an hour after the line current is cut off. The wheel is used to store energy when the hoist is not in operation and is called upon to give up this stored energy when the demand on the line is at a maximum. To obtain this effect, the induction motor is arranged for variable speed work, changes in speed being automatically controlled by the variation of the main line current, which is led through a small three-phase regulating motor operating a water rheostat in series with the secondary winding of the motor.

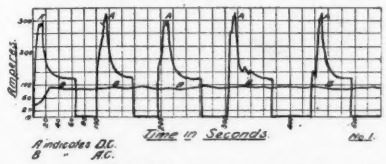


DIAGRAM SHOWING PERFORMANCE OF HOIST OF KENDALL MINING COMPANY.

The torque which is produced by the full-load value of the main-line current in the windings of the regulating motor is exactly balanced by the weight of the moving parts of the water rheostat, so that there is no change in the resistance that is in series with the rotor winding of the motor-generator set so long as the motor is taking full-load current. If, however, it should demand more or less, there is an immediate movement of the water rheostat, tending to accelerate or retard the speed of the motor generator set to such a point that the induction motor once more takes full load and the movement of the water rheostat is stopped. The voltage of the exciter is maintained at a constant value during the speed variation of the motor generator set by means of a Tirrill regulator.

By reference to the diagram taken for the Kendall Gold Mining Company, it will be observed that the input to the induction motor is practically constant and that the undesirable starting peak has entirely disappeared. The direct-current side shows the characteristic hoisting curve where the peak has been overcome by the stored energy of the flywheel.

The Westinghouse Company has developed a system which is very similar to the one described, a notable example of the same being the hoisting sets built for the El Oro Mining and Railroad Company of Mexico. These sets are located 171 miles from the source of power. The largest of these is of 400-horsepower capacity and has been in operation for one-and-one-half years. This generating set is fitted with a 40,000-pound flywheel, nine feet in diameter, mounted between the two machines, the no-load speed of this set being 480 revolutions per minute. This set is used to operate a 400-horsepower direct-current motor that is geared to one of their old steam hoists. The drums are eight feet in diameter and the speed of hoisting 900 feet a minute.

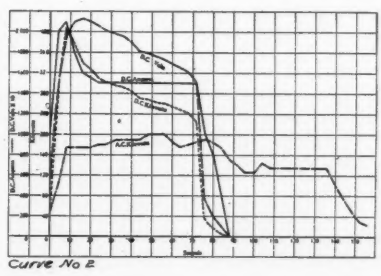


DIAGRAM SHOWING PERFORMANCE OF HOIST OF EL ORO MINE.

The total load raised is 11,445 pounds and the diagram shown herewith shows plainly the relation between the alternating and direct current while hoisting a bucketful of ore from the lowest level. This set consumes twenty-five kilowatts when running empty, and when the current is cut off, the energy of the flywheel will raise a full load 595 feet. The cost of hoisting with this outfit amounts to only seven cents, Mexican money, per 1,000 foot-tons.

In Europe immense strides have been made in the application of electricity to mine hoisting; in fact, induction motors of 3.000-horsepower capacity are in use and a rope speed of over 3,000 feet per minute is attained. In many cases the control and operation of their hoists is almost automatic, so much so, in fact, that the German Government will allow a speed of 1,980 feet per minute when hoisting men by electricity, while with the old reliable steam hoist the speed is limited to 1,188 feet.

The engineers of this country have awakened to the fact of the flexibility of the electric motor for hoisting purposes. and, while it is now in common use, I am firm in the belief that in the next decade its use will be almost universal.

Some Electrodynamic Storage Problems.[1]

In some early applications of electricity to winding engines, storage batteries have been used for storing up energy instead of a flywheel, but the cost of these, and the difficulties of keeping the contacts of the tapping-off switches in order, have prevented a general introduction of this system. Dynamic storage in some such way as first applied by Ilgner to winding engines, and voltage regulation on what may broadly be called the Ward-Leonard system, have made it possible to satisfy the very severe conditions under which winding engines and rolling mills have to work.

In some special cases winding engines are driven direct by three-phase motors, but the motor to which a reversing rolling mill is mechanically coupled is necessarily a direct-current machine. The motor which supplies power to the variable-voltage generator may be either a direct-current or an alternating-current motor. To make the flywheel effective there must be speed variation. Where the original source of power is continuous current, this is, of course, easily obtained without loss of energy. Where three-phase current is the source of power the usual method is to employ a slip-ring motor and some automatic device for inserting and withdrawing resistance in the rotor circuit, but this means some loss of energy, and for this reason the speed range of the flywheel is generally made smaller than with a direct-current plant.

It is, however, possible also in the case of three-phase plant to avoid the loss of energy in regulating resistances by adopting some kind of cascade working. Such an arrangement has been worked out about a year ago by Messrs. Brown-Boveri. The variable rotor resistances are replaced by a direct-current armature working in a three-phase stator, and

1 Abstracted from Dr. Gisbert Kapp's presidential address to the Institution of Electrical Engineers, London, England, November 11, 1909.

the power developed mechanically by this armature may either be added mechanically to that of the three-phase motor, or electrically to the supply circuit. In the latter case an additional generator is, of course, required.

A good example of modern English practice in direct-current rolling-mill electrification is the plant supplied by the Electric Construction Company, Ltd., of Wolverhampton, to the steel works of Sir Alfred Hickman, Ltd., of Bilston. The makers have given me the following particulars:

The flywheel set consists of a 2,000-horsepower direct-current motor, two twenty-eight-ton flywheels and two generators capable of giving any voltage between—1,000 and+1,000 volts. The excitation of the motor is adjusted automatically so as to produce a speed variation of the flywheels between 290 and 350 revolutions per minute. The energy given out when dropping from the higher to the lower speed is 46,000 horsepower-seconds. This set supplies power to a cogging and a barring mill. The cogging mill motor works a thirty-inch mill, and when cogging down ingots of three tons weight has to develop 4,800 horsepower, and for two-second periods once an hour, 9,600 horsepower. The barring mill motor works a twenty-four-inch mill, and has to develop 6,000 horsepower, and for two-second periods once an hour, 12,000 horsepower. The maximum speed is 120 revolutions per minute, and the time occupied in reversing from maximum speed in one direction to that in the other direction is six seconds.

As an example of a reversible mill driven by three-phase current I take that supplied by the British Thomson-Houston Company, Ltd., to Dorman, Long and Company, Ltd. It is a cogging mill with rolls twenty-eight-inch centers, and the normal speed is seventy, the maximum speed ninety revolutions per minute. The flywheel set consists of a three-phase, 950-horsepower, non-synchronous motor, coupled to a 1,000-kilowatt, 400-volt, direct-current generator and a thirty-ton flywheel. The speed limits are 400 and 480 revolutions per minute, and the maximum peripheral speed of the flywheel is 295 feet per second. The mill motor is rated at 1,200 horsepower, and has an overload capacity for short periods of 3,600 horsepower. The time required for reversing from full speed in one direction to full speed in the other direction is four seconds. The mill deals with 1,800-pound billets twelve inches square, reducing them to three-inch square bars in fourteen passes. The output is fifteen tons per hour.

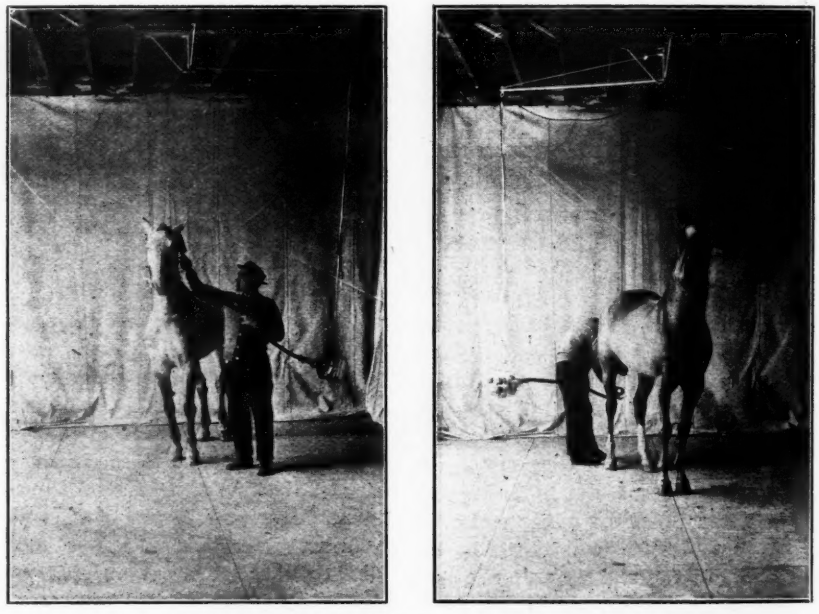
An Electric Groomer and Horse Clipper.

A novel horse-grooming and clipping machine of electro-pneumatic construction has recently been designed which is a remarkable labor-saving device. It consists of variable-speed electric motors operating at from 100 to 5,000 revolutions per minute and equipped with a flexible shaft of piano wire woven into a flexible cable half an inch in diameter.

A friction drive is used for operating a cleaning brush, arranged so that the latter will stop instantly should it accidentally catch the mane or tail. A pneumatic attachment has been devised to utilize the current of air arising from the rapid rotation of the brush to protect the operator from dust and dirt and to deposit the same on the floor.

The cost of electric current for operating this machine is said to be less than $5.00 per month for fifty horses. The machine can be instantly changed from a grooming to a clipping machine and may be run either fast or slow as desired, cleaning a horse wet or dry, and removing anything that can be done with a curry comb and brush in one-quarter the time required by hand.

It will be noted from the illustrations that the motor is suspended from a swinging arm attached to the ceiling, a flexible cord extending from the motor to the support. The current can be supplied from an ordinary incandescent lamp socket. The pneumatic brush removes the fine dry dust that it is impossible to extract with an ordinary brush by hand. It is claimed that from $600 to $1,000 per year may be saved in labor alone in grooming and clipping fifty horses with this device, while the horses are cleaned better than it is possible in any other way.



THE ELECTRIC GROOMER AND HORSE CLIPPER.

An Electrically Propelled Ship.

William P. Dartnell, in acknowledging the presentation (November 15 last) to him of the Denny gold medal of the Institute of Marine Engineers, in England, for his paper on "The Generation and Electrical Transmission of Power for Main Marine Propulsion and Speed Regulation," read before the Institute in July, 1908, said that a cargo boat was being fitted with his Paragon system of electrical propulsion, and that he would be pleased to report the results of the trials of the vessel as soon as they could be ascertained.

Heat Transmission from Electro-Copperplated Copper Sheets.

Experiments which were recently made at the Worcester Polytechnic show that copper sheets which have been electro-deposited with copper possess much greater heat-transmission properties than ordinary copper sheets which have not been so coated. It is suggested that this property may affect the design of condensers, radiators, etc.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

AMERICAN TELEPHONE AND TELEGRAPH.

The American Telephone and Telegraph Company has filed with the Massachusetts Commission a report covering the operation of the company for the year ended June 30, 1909. The income account compares as follows:

	1909.	1908.
Gross	$15,025,518	$14,541,484
Expenses	7,496,508	7,384,980
Net	$7,529,010	$7,156,495
Other income	19,684,657	18,382,448
Total income	$27,213,667	$25,538,943
Charges	7,794,254	7,641,786
Surplus	*$19,419,413	$17,897,157
Dividends	13,970,355	11,801,680
Total surplus	$5,449,057	$6,095,477

*Equal to 8.16 per cent on the $237,788,100 capital stock, as against 9.91 per cent on $180,587,000 stock a year ago.

The Associated Bell Operating Companies of the American Telephone & Telegraph Company, not including the long-distance lines of the American Telephone and Telegraph, report for the month of October and ten months ended October 30as follows:

	1909.	1908.
October gross	$11,811,174	$10,692,178
Operating expenses and taxes	4,753,410	4,611,121
Balance	$7,057,764	$6,081,057
Maintenance and depreciation	3,690,590	2,939,791
October net	$3,367,174	$3,141,266
Interest	621,441	621,390
October surplus	$2,745,733	$2,519,876
Ten months gross	111,645,624	103,465,265
Operating expenses and taxes	45,868,553	44,717,962
Balance	$65,777,071	$58,747,303
Maintenance and depreciation	34,961,784	29,297,426
Ten months net	$30,815,287	$29,449,877
Interest	5,712,912	6,388,316
Ten months surplus	$25,102,375	$23,061,561

The 1908 figures include in expenses for each month 1-12th of the extraordinary provision for depreciation made in December, 1908.

Unexpended portion of provision for the first ten months of 1909 was $10,977,527, not counted as profits but remaining as reserve for future replacement.

H. P. Davison, of New York, and John J. Mitchell, of Chicago, have been elected directors of the American Telephone and Telegraph Company to fill vacancies.

TOLEDO RAILWAY AND LIGHT.

Practically all of the $4,866,000 outstanding four per cent consolidated first mortgage bonds of the Toledo Railway and Light Company, which fell due July 1, 1909, and on which the company is in default as to three interest payments, have been deposited with the bondholders' committee; and seventy-five per cent of the $13,875,000 capital stock is in the hands of the stockholders' protective committee. These committees are working in harmony.

No plan for financial readjustment has been formulated. The new Toledo council will meet in January and at that time it is expected the question of extending the street railway franchises of the company will be considered. Of the present franchises, those for 9.5 miles of street expire in 1910; for forty-two miles in 1914; and for twelve miles in 1915. Until it is known that a renewal of these franchises will be granted no refunding of the present bonded debt of the company can be done.

Arrangements have been made by which the interest on the underlying bonds of the company will be paid when it falls due in January. The time of payment of the five per cent bonds of the Consolidated Street Railway Company, and the Toledo Traction Company was extended from January 1, 1909, to January 1, 1912.

Gross earnings of the company for October were $239,374, showing an increase of $21,300 over last year. Expenses increased about $10,000, and fixed charges $4,000, leaving a surplus for the month nearly $8,000 better than last year.

METROPOLITAN STREET RAILWAY.

The Public Service Commission has rendered a report covering the operations of the Metropolitan Street Railway Company receivers for the eleven months ended June 30, 1909, from which the following is taken:

Passenger fares		$11,689,546
Advertising privileges		221,467
Rent of tracks		10,259
Rent of equipment		44,929
Total revenue from street railway operations		$11,966,203
Maintenance of way and structures		$1,229,774
Maintenance of equipment (including $62,121 renewal of horses, etc.)		1,334,385
Operation of power plant—electric	$708,763	
Credit power sold	(b) 157,903	
		550,860
Horse car stable expenses		185,133
Operation of cars		3,234,348
General expenses		2,046,862
Total expenses of street railway operations		$8,581,363
Net revenue from street railway operations		$3,384,839

NEW YORK CITY RAILWAY.

The Public Service Commission has rendered a report covering the operations of the New York City Railway Company, receiver, lessee of the Metropolitan Street Railway Company for the month of July, 1908, which was in part as follows:

Total revenue from transportation	$1,205,663
Advertising privileges	20,895
Rent of tracks and equipment	1,121
Williamsburg Bridge tolls	848
Total revenue from operations	$1,228,528
Maintenance of way and structures (b)	251,441
Maintenance of equipment (including $9,632 in horse car service) (c)	331,057
Operation of power plant (horse, $32,120; electric, $68,993)	101,114
Power bought, sold or exchanged, not credit (d)	1,719
Operation of cars	373,141
General expenses	209,299
Total expenses of operations	$1,264,333
Net loss from street railway operations	35,805
Net revenue from outside operations	16,203
Total net loss	$19,602

WESTERN UNION'S EARNINGS.

The Western Union Telegraph Company has issued its quarterly statement for the three months ended September 30, 1909, which compares with the returns for 1908 as follows:

	1909.	1908.
Net revenue	$1,929,275	$1,864,955
Bond interest	433,062	433,062
Balance	$1,496,213	$1,431,893
Dividends	747,492	497,820
Surplus	$748,721	$934,073
Previous surplus	17,269,278	14,393,856
Total surplus	$18,017,999	$15,327,929

The preliminary quarterly report (partly estimated) for the quarter ended December 31, 1909, compares with 1908 as follows:

	1909.	1908.
Net revenue	$2,000,000	$1,930,064
Bond interest	433,063	433,063
Balance	$1,566,937	$1,497,001
Dividends	747,492	747,025
Surplus	$819,445	$749,976
Previous surplus	18,017,999	15,327,929
Total surplus	$18,837,444	$16,077,905

The earnings (partly estimated) for the six months ended December 31, 1909, compare with actual figures for the corresponding six months of 1908 as follows:

	1909.	1908.
Net revenue	$3,929,275	$3,795,019
Bond interest	866,125	866,125
Balance	$3,063,150	$2,928,894
Dividends	1,494,984	1,244,845
Surplus	$1,568,166	$1,684,049
Previous surplus	17,269,278	14,393,856
Total surplus	$18,837,444	$16,077,905

WESTINGHOUSE ELECTRIC.

The business of the Westinghouse Electric and Manufacturing Company shows material improvement. In the month of November shipments from Pittsburg and Newark aggregated a total valuation of about $2,500,000. Including other subsidiary companies, the total shipments ran close to $3,000,000, the largest month in some time past.

There is no basis for the report that the Westinghouse Electric and Manufacturing Company proposes to pay off the entire back dividends on the preferred stock. Dividends will be paid off gradually.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Westinghouse Electric and Manufacturing Company's New Repair Department.

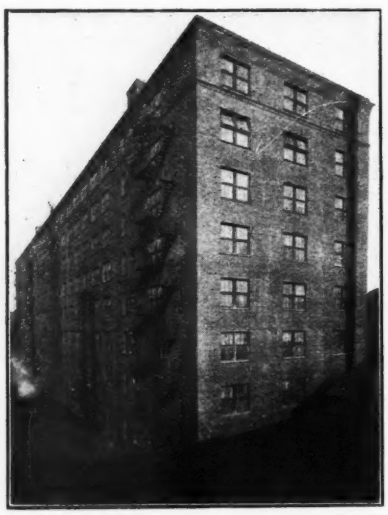
The new eight-story building, with approximately 220,000 feet of floor space, devoted partly to the manufacture of detail electrical apparatus and partly to repair work, which the Westinghouse Electric and Manufacturing Company not long ago placed in service, contains a new department, whose entire attention is devoted to the handling of repair work.

For some time past the need of a special department to handle repair work independently of all other work, so as to insure prompt attention and quick deliveries, has been strongly felt, but the crowded condition of the works required the erection of another building before such a department as the management had in mind could be established.

On account of the fact that there was no large space on the company's forty-seven-acre plot unoccupied, it was necessary, in the erection of a new building, to depart from the established two-story type of structure and erect a higher building. The available space was 110 feet wide by 420 feet long, and the building is 70 feet by 400 feet. The distance from the ground to the top of the cornice is 130 feet. The building is of skeleton self-contained steel and brick constrution, and is as near fireproof as a building can be made.

Although surrounded on all sides by other buildings, the new building has excellent receiving and shipping facilities. A covered shipping platform on the east side, paralleled by a railroad siding, extends the full length of the building. The ground floor is connected with the rest of the works by a narrow gauge industrial railway system, and the second floor is connected with the surrounding buildings by means of covered bridges.

INTERIOR VIEW OF FOURTH FLOOR, WESTINGHOUSE REPAIR DEPARTMENT.



VIEWS OF WESTINGHOUSE ELECTRIC AND MANUFACTURIN G COMPANY'S NEW REPAIR DEPARTMENT, EAST PITTSBURG, PA.

To facilitate the handling of material from floor to floor one exceptionally large freight elevator and five high-speed combination elevators are employed. They are all electrically operated by means of Westinghouse motors and controlled by automatic elevator controlling apparatus.

The building affords working space for approximately 1,500 people In addition to providing for practically doubling the present output of detail apparatus, it affords ample room for handling in the most expeditious manner a large volume of repair work.

The desirability of having electrical apparatus repaired by a manufacturer is apparent to every user, and the facilities afforded by this new department will no doubt be taken advantage of by all who have apparatus that needs overhauling and repairing.

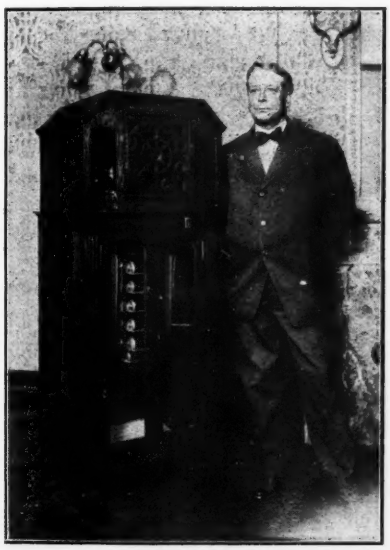
In keeping with the well established standards of the company the same high grade and carefully selected material that entered originally into the apparatus will be used in work entrusted to the repair department. Expert workmen, under the guidance of engineers of long experience, perform the work, and repaired apparatus is subjected to the same rigid tests as new apparatus. The facilities of the department enable repairs to be made in the most economical manner, and assure it redelivery in the shortest time consistent with good workmanship.

Among several suggested new uses for electrical vacuum cleaners is the grooming of horses. A special suction currycomb is now on the market which can be obtained to the cleaner tube.

The Multinola; an Electrically Operated Multiple Phonograph.

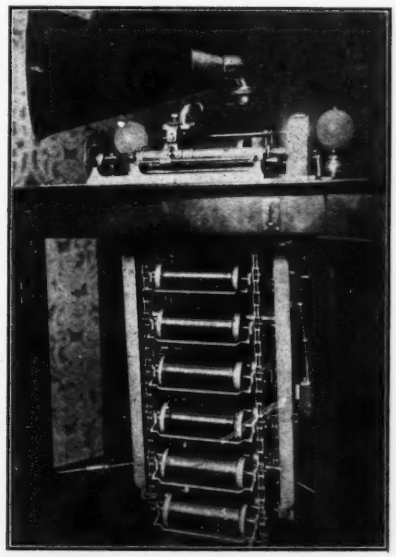
An "automatic continuous multiple phonograph," known as the "multinola," has, for the past few weeks, been attracting attention in New York city, where it was recently exhibited and demonstrated by the inventor, Dr. George S. Iddings, who is shown standing by the side of the instrument in one of the two illustrations shown herewith. Musical experts and others who have been present at the demonstrations have commented favorably on the quality of tone of the new phonographic device, which was characterized as being mellow and soft, yet withal loud and brilliant, and without the harshness usually associated with mechanical talking machines.

The essential improvement in the new machine is said to be in the "speaker." The mechanism of the reproducer differs to a certain extent from those familiar to the trade in the "limiting" and the "float," which are covered by special patents already allowed, it is said, in the face of a severe interference fight in the Patent Office. A "shutter" on the reproducer cap eliminates the "blast" and softens the tone, and which may be regulated at will. The diaphragm of the sound box is of corrugated metal, and a ball or button sapphire point, as may be desired, is used. The amplifying horn is attached to a straightaway tone arm, with only a couple of turned elbows that materially aid in the clear conveyance of the sound.



VIEW OF THE MULTINOLA ELECTRIC PHONOGRAPH COMPLETE.

The mechanical parts of the machine differ materially from those employed on the ordinary slot machine. A drop mandrel, on two endless revolving chains, is controlled by a series of cams and springs. Two governors on the machine bedplate drop the mandrel and wind the springs, which latter are placed in the rear of the record carrier. The record carrier, working on twin endless chains, conveys the record, presenting each of the records in turn as its predecessor finishes playing. By means of a dial any particular record may be selected by number and played; or it may be repeated indefinitely by touching a button. When running regularly, as each record is completed it drops from under the reproducer, descending and taking its place in the carrier, another coming up and presenting itself automatically, with an interval of only about twenty seconds. The records are easily removed or inserted without stopping the machine or interfering the slightest with its operation in any way. The present machine is built to accommodate sixteen records.



MULTINOLA PHONOGRAPH SHOWING LOCATION OF RECORDS.

An electric current from an ordinary electric-lamp socket will operate the multinola, the mechanism being started by inserting a coin or token.

At the meeting of Armour Institute Branch of the American Institute of Electrical Engineers held in Chicago, December 16, Prof. G. M. Marsh presented a paper on "Wireless Telegraphy."

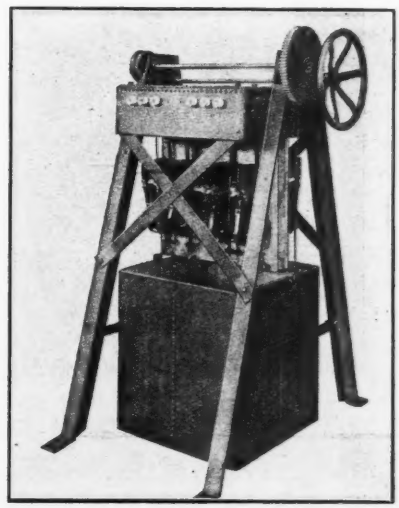
A High Tension Contactor Panel.

A very desirable feature possessed by the electric motor as a source of power is the ease with which it lends itself to remote control, through proper devices.

The panel shown here is designed to control a 750-horsepower 2,080-volt squirrel cage induction motor. This motor drives a centrifugal pump used in connection with a suction dredge to assist in forcing the material through pipes in order that it may be discharged at a distant point. Due to the high voltage, the contactors for connecting the motor to the compensator and to the line after the starting period are oil immersed.

The motor and panel are located at a distance from the dredge and the panel is designed for control from the dredge, as there will be no attendant at the point where the motor is installed.

The overload device on the control panel is so connected that in case the motor becomes overloaded, the control circuit is opened at the dredge and this in turn opens the motor circuit by means of the contactors, thus making it possible in case of a temporary overload to start the motor again from the dredge.



CONTACTOR PANEL WITH OIL RECEPTACLE LOWERED.

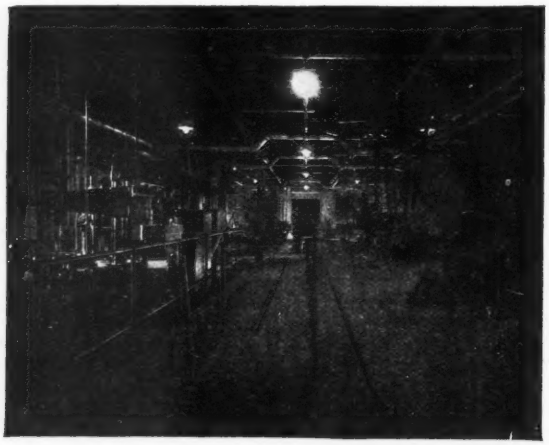
This panel is manufactured by the General Electric Company at its Schenectady works.

Electrical Business Good.

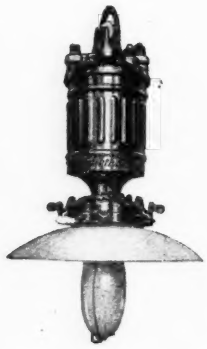
A recent report states that November was one of the best, if not the best, month of the year in the matter of business booked by the General Electric Company and also by the Westinghouse Electric and Manufacturing Company.

Arc Lamp Illumination for Iron Working Shops.

With the development of the carbon enclosed arc lamp and its general commercial introduction for interior illumination, there has come about an important step in the artificial lighting of large interior areas. This type of lamp has produced an illumination which has enabled the eye to see better, and, therefore, has had a cheerful acceptance as a source of high efficiency in the actual production of light. Another, and probably the most valuable thing which the enclosed arc has accomplished is the practical demonstration of the importance and value of diffusion, and in bringing out the most basic fact of illuminating engineering, which is that the proper utilization of light is quite as important as its proper production.



GENERAL VIEW OF FACTORY SHOWING LOCATION OF LAMPS.



TYPE OF LAMP INSTALLED IN SHOPS.

Arc lighting practice has practically settled on indoor lamps using approximately five amperes and eighty volts at the arc for direct current and six amperes and seventy volts for alternating current. For high ceilings, with little obstruction, the above rating does very well; for low studded ceilings and rooms with objects throwing heavy shadows, enclosed arc lamps give better distribution and more even illumination with a rating of three amperes and eighty volts at the arc for direct current and four amperes and seventy-five volts at the arc for alternating current. Besides this, low voltage lamps should always be equipped with carbon of a smaller diameter, so that the light emitted from the crater tip, which is at white heat, may have a predominating effect.

For very low ceilings, the ordinary length carbon arc gives a somewhat uneven distribution of light, and to meet such conditions a short enclosed arc has now been developed and is being manufactured by the Western Electric Company to meet such demands. These short arcs are 20 inches over all, and have a life of from 80 to 100 hours, which makes them in every way adaptable to circuits which are already operating lamps of the ordinary type.

Next to the choice of an arc lamp for indoor lighting is the laying out of a lighting equipment. As already stated, the one principle to be observed in the economic and efficient operation of any lighting system is a proper utilization of the light. In order to determine the number of lamps for the lighting of any given area, it is not only necessary to know the exact area, height of ceilings and objects to be illuminated, but considerable attention should also be given to surroundings, because very frequently the color decorations and tinting of the walls play an important part.

The following illustrations show alternating current installations at the Western of Alabama Railway Shops at Montgomery, Alabama:

For the inside shop service a 7.5 ampere, 110-volt lamp is used. This lamp shown in an accompanying illustration is trimmed with one solid and one cored carbon, which remedies the unsteadiness resulting when two solid carbons are used, the reason for this being that the resistance of the arc depends upon the current, it being high for a low current and low for a high current. It can, therefore, be readily seen that if the current increases from zero to maximum and then decreases from maximum to zero that the resistance will drop from a high value to a low value and then rise. This pulsation of resistance results in a distortion of the wave forms of the current, so that the real watts divided by the apparent watts is called the power factor of the arc. Since the resistance of the arc, therefore, is affected by the carbons, it can be seen that the power factor of the arc having one cored and one solid carbon is different from one equipped with two cored or two solid carbons.

The purpose of the cored carbon in alternating-current lamps is, therefore, to decrease the arc resistance and permit the establishment of the current through the arc when the electromotive force of the arc is near its zero point.

The other type of lamp which is used for illuminating the train sheds is a six-ampere, 110-volt series, alternating. This lamp when not in service stands cut out, so that when the lamp is switched on and the current enters it a portion of the current is shunted through the starting resistance, thereby energizing the series magnets which open the path of current through the starting resistance. Since the entire current now passes through the series magnets, the carbons are separated and the arc established. When the voltage rises above normal the shunt magnet becomes more strongly energized and by bringing the cut out contacts into engagment short-circuits the arc. The winding of the shunt magnets is such that by connecting the coils in series the lamp can be operated on sixty-cycle circuits, while by connecting the coils in multiple the lamp can be operated on 125-cycle circuits.

An important consideration other than the ones already mentioned in the installing of the arc lamp is the estimating of the capacity for transformers which are used and the wiring of these transformers. The capacity of the transformers to supply constant potential alternating current arc lamps should be based upon the volt amperes required by the lamp and not by the watts. In this way the size of the transformer is obtained such as to operate most efficiently, and, therefore, enable the lamps to in turn operate with the desired effect. The wiring between transformers and lamps should be heavy enough, so that there is no excessive drop in voltage. Lamps require when starting a current of about ten or twelve amperes, and too great

a reduction of terminal voltage prevents the lamp from starting. Besides this, the carbons of the alternating-current lamp when allowed to run on very low terminal voltage are apt to glaze, thus covering the carbon tips with a high resistance deposit and causing the arc to be unsteady.

The installation at the Western of Alabama Railway Shops is a typical arc lamp installation, using the latest types of the enclosed carbon arc lamp embodying the features as described. These lamps have been in service for some time, and burn with a regular trim of from 80 to 100 hours. The layout of the system was very carefully planned by the illuminating engineers of the Western Electric Company, which company also supplied the lamps and transformers.

Flaming Arc Lamps to Be Changed in Newark.

The special lighting of Market Street in Newark, N. J., which was described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of November 20, has caused some controversy between the Market Street Business Men's Improvement Association and the Public Service Corporation of New Jersey. The lamps that were made use of, it will be remembered, were Toerring flame arc lamps. The busienss men protested that the service was not what was expected, and as an outcome of the dispute, it has been decided to substitute fifty-eight pairs of Excello flaming arc lamps. At the same time that these lamps are exchanged the lamp posts will be cut down seven feet, thus making the lamps only two feet higher than those on Broad Street south of Market. The Public Service Corporation is willing to make the change, even though it will be necessary to expend $6,000 to bring it about.

Electric Search Lights for North Carolina.

That the United States Government is more and more keenly alive to the value of electric search lights is shown by the fact that new installations are continually being made. The latest case reported is that of the Cape Fear light house at the mouth of the Cape Fear River in North Carolina. The present thirty-six-inch search light now in use is to be replaced by three sixty-inch projectors. L.

High-Tension Entrance Tubes.

One of the important requirements in high tension transmission systems is that some method be provided for bringing high tension conductors into the station. Appreciating the demand for a reliable, convenient method, the Central Electric Company, Chicago, Ill., is marketing the type of entrance tube illustrated herewith and which fully meets the requirements of high insulation, exclusion of snow, rain, dust, etc.

Fig. 1 illustrates an entrance tube designed for capacities up to 300 amperes

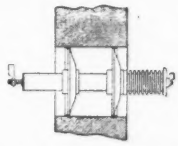


FIG. 1. ENTRANCE TUBE.

at 13,200 volts. This device consists of three elements, a pair of highly glazed porcelain discs, a specially designed porcelain tube and a copper conductor extending the entire length of the tube. The horizontal tube is securely fastened to the supporting discs and this forms a self-contained unit substantial in construction and easy to install. The copper core is provided with terminal lugs at both ends to which the line conductors are soldered.

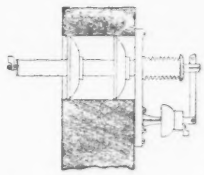


FIG. 2. ENTRANCE TUBE AND DISCONNECTING OUTLET.

The construction adopted insures a weatherproof, air-tight structure which not only has a permanently high insulation factor, but also effectually excludes rain and snow. Another feature of this entrance tube is that it does not afford a place for birds to build nests as is more or less common with the open type of entrance. It also prevents insects from getting into the station.

The use of high tension disconnecting switches is rapidly increasing, especially as their value and flexibility is being recognized. To meet the demand for a combined entrance tube and disconnecting switch the combination shown in Fig. 2 has been developed. This disconnecting switch is mounted on a two-inch marble slab, which in turn is secured to the station wall.

By the use of this combination the high tension cannot only be safely brought into the building, but when found desirable or necessary the circuit can be absolutely "killed" at this point. These new entrance tubes will be found of much convenience from a construction standpoint, for it is only necessary to leave a circular hole of the proper diameter into which the entrance tube can be cemented after all the work is completed. The construction adopted eliminates the necessity for skilled labor, as but one thing has to be done; that is to place the device in position and cement the edges.

New Type of Fuse.

A new type of fuse known as the "Tidmarsh" recharging enclosed fuse, which, it is claimed, can be refilled for a price decidedly less than that of a new fuse, is being placed on the market by the Long Beach Electric Manufacturing Company, Long Beach, Cal.

This fuse, shown in the accompanying illustration, is made in all sizes and will fit all cut-out blocks that comply with the dimensions specified by the National Electrical Code. The body is made of fiber tubes and the brass caps are held to the tube by a brass pin. The cap that fits over the fiber tube is threaded and is perforated to let the copper ends of the fuse strips through. These holes are made to correspond with the different sizes of fuse strips. The top cap is attached and screws

NEW TYPE OF TIDMARSH RECHARGING ENCLOSED FUSE.

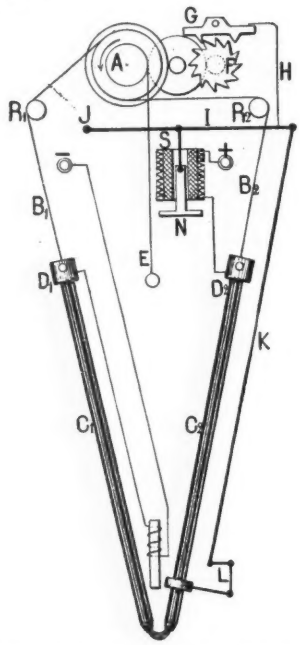
down over the first cap; thus when the copper ends of the fuse strips are between two caps it makes a mechanical connection without soldering.

The fuse strips are made of ribbon fuse and have two trimmed copper strips soldered to each fuse. These strips are trimmed so that if used in damp places they will not corrode.

Among the advantages claimed by the manufacturers of this type of fuse is that the repairman cannot replace the fuse strip with copper wire without detection. Another advantage claimed is that when the fuse blows out the trouble may be detected by unscrewing a cap at either end and pulling the fuse. If it has been burned out it can be moved about one-half inch; if not the fuse cannot be moved.

The A B C Flaming Arc Lamp.

The necessity of obtaining light of ever greater intensities from arc lamps tends to generalize the employment of mineralized carbons. A vertical disposition of such carbons is frequently connected with certain drawbacks, and the manufacturers of the A B C lamp have therefore adopted the converging arrangement. This is a little more complicated than the former as it requires, besides the downward, also a lateral movement of one of the carbons in order to start the arc, but it has the advantage of insuring reliable working and a better downward distribution of the light.



MECHANISM OF A B C FLAMING ARC LAMP.

The mechanism of the lamp, which is diagrammatically illustrated herewith, includes a drum A with three grooves. The two outer ones receive cables B_1 B_2, which pass over guide pulleys and support the carbon holders D_1 D_2. The center groove receives a cable E which serves for raising the carbon holder when the carbons are renewed. The drum is connected by gears to a wheel F, which is controlled by the oscillating escapement G. The drum A, which the weight of the carbons tends to turn in the direction of the arrow, can turn only when the piece H is sufficiently raised to permit G to oscillate. The displacement of the piece H is regulated by the core H of coil S and a lever I. The latter is also provided with a rod K which, by means of an angle lever L, produces the lateral displacement of carbon C_2 for starting the arc. The lever is actuated by the electromagnet S, which has two windings, one of fine and one of heavy wire. Upon closing the circuit a feeble current flows through the fine wire, the core of the electromagnet is raised, the carbons approach each other and the arc is started. As soon as this takes place the heavy winding is traversed by the main current. Its action is in a direction opposite to that of the first, the lever I drops, the carbons separate and escapement G is arrested. When on account of the consumption of the carbons the resistance of the arc becomes high, the escapement is released and the carbons drop a little. The lamp is also provided with an electromagnetic blower, which prevents the arc from starting too high. Two lamps may be operated in series on a 110-volt circuit and the carbons last from ten to eighteen hours. The power consumption is from 0.16 to 0.20 watt per candlepower. — *From L'Electricien, Paris, November 13, 1909.*

The Wire and Telephone Company of America Changes Its Name.

Owing to the fact that the business of the Wire and Telephone Company of America, Rome, N. Y., is devoted exclusively to the manufacture of the well-known "Romeoid" bare and insulated electric wires the company has taken steps to change its corporate name and hereafter will be known as the Rome Wire Company.

In addition to the reason given for changing the name the company feels that the new name will be easier to write and speak. Also the company takes pride in the industrial development of the city of Rome and the new name bringing the name of the town first has a significant advertising value.

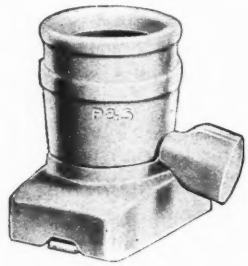
The management and policies of the company will remain the same.

Street Car Emergency Equipment for Injuries to Passengers.

There is an equipment on the Rotterdam street cars which could well be adopted in the United States at a very small cost. Every car is supplied with a small first aid to injured package. The bundle, carried in the car alongside the register, contains some material for bandages and such things as would be handy in case of minor injuries to the crew, passengers, or pedestrians.

New Pass & Seymour Receptacles.

In the new line of porcelain lamp-receptacles manufactured and placed on the market by Pass & Seymour, Inc., of Solvay, New York, there are several features which add greatly to the convenience of installation. Where the key receptacle, shown herewith, is used, it is not necessary to cut the lighting wires or the moulding. The receptacle is mounted directly on top of the mould-



MOLDING TYPE RECEPTACLE.

ing and the wires of the lighting circuit looped over the terminal plates.

The condulet style of socket is made for use with the standard types of Crouse-Hinds condulets and makes an exceedingly neat installation.

Both the moulding and condulet re-

CONDULET TYPE RECEPTACLE.

ceptacle have been approved by the Board of Underwriters, and are covered in the card of September 24.

An Electrical Bug and Moth Trap.

Wine growers in the vicinity of Rheims, France, have recently devised a unique way of exterminating the bugs and moths which are so detrimental to their vineyards. A number of posts were placed at intervals of seventy-five feet in parallel rows about seventeen feet apart. On each of these posts was placed a five-candlepower electric lamp and under this was suspended a dish containing water with a top layer of petroleum. When the current was turned on the insects swarmed toward the lights and were killed in great numbers either by the fumes of the petroleum or by dropping into the dish.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, DECEMBER 3.—The event of the week has been the opening of the single-phase railway in the south of London, of which a good many particulars have already been published. The opening was carried out without any ceremony whatever, the trains just being worked into the ordinary timetable, although this has been considerably altered to meet the greater speed of the electric trains. This necessitates the running of several of the steam trains as through trains for certain parts of the route.

Evidence of the great difficulty which is being experienced in Great Britain in introducing electrically-driven road vehicles is seen in the winding up of all the provincial companies which were formed a few years ago for running electric omnibuses. These were formed as affiliated companies of the London Electrobus Company, but the necessary funds have never been forthcoming and all their names have now been struck off the register of joint-stock companies. In his same connection may be mentioned the balance sheet of the Electromobile Company, a concern which is chiefly occupied in hiring out electric vehicles in London for private purposes. The accounts of the company now show a total loss of $32,000.

For many years there has been an outcry on the part of tramway companies that the exactions of local authorities have had the result of bringing the fares down to a point when the profit vanishes. This result has been mainly brought about by the demands of the working men to have lower fares and of concessions to school children to travel at half fares; in some instances universal halfpenny fares have been advocated.

As the largest electric-traction company in the country, the British Traction Company has been seriously affected by the prevailing tendencies in regard to fares, and many suggestions have been put forward in order to remedy the position and to resist the claims of the local authorities. Anything in the nature of raising the fares has had to be put out of the question, but a trial is to be given to a new system of fares which has been called the "Fair-Fare System." This consists of having a minimum fare of one penny, but of dividing tramway routes into farthing stages. Whether this will work remains to be seen, but it has rightly been pointed out that whereas it may do so in a purely working-class district, in the case of those districts inhabitated by business men and the better-class population, the worry of being bothered with farthings may well be one which will cause people to travel less by tramcar. However, the system is to have a trial in a large number of places controlled by the British Electric Traction Company, as from January 1, and in order to assist passengers in recognizing the section to which they are entitled to travel, the posts are being distinctively painted and numbered.

An electric supply company in the south of London has adopted a novel plan of demonstrating the uses of electricity in domestic service. This company has opened an "electric home" in the true sense of the word. Many an electric home has been installed at exhibitions and the like, but in all these instances the "home" has been a purely ornamental one. In this case, however, arrangements have been made with a householder to instal his house with electricity from floor to roof, and in return the tenant agrees to allow the house to be inspected at any time, by anyone producing a permit from the electric supply company. Electric power is used for every service in the house, including lighting, cooking, heating, ironing, the sewing machine and so on, and as an advertising method is bound to be exceedingly successful. One hardly knows which to admire the most, the company for putting such an idea into force, or the tenant for his courage in throwing his house open to inspection at all times. But the conveniences which are afforded are certainly worth some sacrifice.

Some time ago the Sydney Corporation had a discussion as to the most suitable speed at which to run its turbo-alternators. This question arose in connection with tenders for two 4,000-kilowatt turbo-alternators, and the engineer recommended a speed of 750 revolutions per minute. Some wiseacre on the council, however, claimed that cheaper machines could be installed running at 1,500 revolutions per minute and at the council meeting at which the matter was discussed, it was decided to refer the matter back to the committee with instructions to invite fresh tenders for machines at the higher speed. Whether this was ever done, I am in some doubt, but it is a fact that a tender from a British firm has now been accepted for machines running at the lower speed, the price not being the lowest.

It was stated in the House of Commons this week that the whole of the supply of arc-lamp carbons for the British Navy is purchased in this country. In this connection it is of interest to note that there is only one firm manufacturing such carbons in Great Britain.

From a remark made in the House of Commons this week, it would seem that the Government contemplates bringing in a new bill dealing with wireless telegraphy, in view of the operation of the Radiotelegraph Convention and the purchase of the Lloyds and Marconi stations.

There are many outward and visible signs that supply authorities—and particularly the London borough councils—are making a strong bid to develop electric heating and cooking, by a rearrangement of tariffs. At Marylebone it has been decided to charge two cents per unit for all supply to apparatus having a 100-per-cent load factor, and at Hampstead a definite standing charge, plus two cents per unit, is offered for any supply for heating and cooking. In the same direction is the offer of the Brighton Corporation to wire any premises for lighting and cooking, etc., free of charge, if the consumer will agree to pay two cents per unit more than if he paid for his own wiring. In this connection it is interesting to note that there is a difference of opinion as to whether the development of lighting in small premises should be at twenty-five volts or at a higher voltage. It is argued, on the one hand, that such premises are never likely to adopt electric heating, whilst those of the opposite view take the stand that whereas, hitherto, electric supply authorities have complained of their bad load factor, by adopting twenty-five-volt circuits, they are depriving themselves of any chance of improving their load factor in as much as this wiring will not do for heating circuits. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, DECEMBER 3.—A recent electrical enterprise in the eastern part of France is the erection of a hydraulic plant by a local company known as the Union Electrique. The new plant is to be located in the Jura region, where the same company is now operating a turbine station of 5,000 horsepower. The present station is being erected for a capacity of 4,000 horsepower, and it is expected to have it finished and in running order about the end of this year. In addition to the hydraulic outfit of the plant there is being installed a steam plant which is to serve as a reserve. These latter machines will have an output of 2,000 horsepower. In connection with the present work there is being constructed a network of power lines of considerable extent, which will cover the part of the Jura region lying around the two hydraulic plants.

In Italy several electric plants are in course of erection as well as extensions of power lines from existing stations to various communes. Among the extensions I note the enterprise carried out by the Filovia company at Coni. It is to erect a power line running between this locality and the town of Peveragno. The current will eventually be used for operating an electric railway. The Murandi firm has secured the rights for a power line running from Camposampiero to Soreggia in order to supply this latter town with current for motors. The Norrembourg firm of Rome recently obtained the concession for a light and power line which is to connect Anticale with Guarino. A carbide works located in the neighborhood of Ascoli is to receive a supply of current from a hydraulic plant. This latter station is situated in the commune of Aqua Santa.

The municipality of Bukharest is engaged in building an electric station of considerable size, this to cost about 2,000,000 francs for the part which is to be shortly finished. However, there are plans already made for a new plant which is to be added to the present one and it will be of still larger output. The cost of the new station is figured at 3,500,000 francs, and it will likely be erected in 1916. In the meantime, the plant which is now in construction will furnish current for the outlying quarters of the city as well as for tramway lines.

The following new companies have been formed at Paris: Hegmann and Billaudel, for storage battery manufacture; Linot et Cie, who will make various kinds of electrical apparatus; the Electric Light and Water Enterprise Company; Simon Brunschwig et Cie, for electrical supplies; Hinaux & Thomas, electrical apparatus; the Power Distributing Company for the Centre of France.

As regards recent projects in France, I note that the Municipal Council of Nuits, St. Georges, is taking measures to have the Dijon suburban traction-line extended to that locality. It is proposed to undertake a further extension of the Roubaix tramway line in the direction of Tourcoing. At Angoulême, the local council is arranging with the light and heating company for a supply of current for lighting and power. The town of Castillon is considering a project for electric lighting. At Angers it is proposed to extend the electric lighting system within a short time. The Municipal

Council of Saida, Algeria, has recently adopted an electric-lighting project.

The electric stations of Berlin have commenced the use of a coin-operated electric-meter, and it appears to be operating with some success. It seems to give a supply of current without involving any great expense on the part of the consumer, seeing that the company furnishes the meter as well as all the wiring, in this way reaching a class of customers who would not likely use the current otherwise. Added to an ordinary meter is a coin-operated switch, which throws on the current upon introducing a ten-pfennig coin, and the meter commences to register the current consumed, then the switch cuts off the current after the standard amount is passed. By putting in another coin the operation is continued.

A large turbine plant is to be erected in the north of Italy for electric railroad use, and the executive council of the State Railroad, has just approved the project. It will be one of the largest hydraulic plants in the country, and is located at Vado, on the Ventimiglia-Savarna Railway line. The Minister of Public Works has recently approved the plans for the construction of an electric railroad line from Ponte di Nossa to Clusone.

The Rheinfelden plant in Germany is to furnish a considerable amount of current over a power line to the city of Mulhausen. An agreement to this effect has been concluded between the city council and the Rheinfelden company.

The tramway company of Moscow is planning a considerable extension of the lines in the city and suburbs, and this is to involve an outlay of approximately $20,000,000, according to the present ideas. A de C.

LIGHTING AND POWER.

(Special Correspondence.)

ARLINGTON, S. D.—H. P. Mortenson is considering the establishment of an electric-light plant. P.

AINSWORTH, NEB.—The Ainsworth Light and Power Company has been incorporated with a capital of $60,000. P.

COLUMBIA FALLS, MONT.—The North Idaho & Montana Power Company is asking for a franchise in this city. P.

NICKERSON, KAN.—This city has voted bonds for the establishment of an electric-light plant.

DECATUR CITY, IA.—Johnson & Smith have been granted a franchise for an electric-light plant. P.

WATERTOWN, S. D.—Ferris Brothers are about to establish an electric-light plant here to cost $100,000. P.

COLUMBIA FALLS, MONT.—Mr. Farrar has applied to the city council for a franchise for an electric-light plant. C.

NORWALK, CONN.—The Heating and Lighting Company of this city has filed a certificate of incorporation, with $18,700 cash capital.

CONRAD, MONT.—Plans for an electric-light and water-works system will be prepared by C. T. Sacker and C. D. Flaherty, engineers, of Livingston, Mont. C.

RAMONA, S. D.—The Citizens Light and Power Company let the contract to H. P. Mortensen, of Toronto, S. D., for the installation of an electric-light plant for $2,000. C.

SAN DIEGO, CAL.—The city council has accepted the bid of the San Diego Consolidated and Electric Light Company for a five-year contract for street lighting. A.

WAYCROSS, GA.—The city has granted an electric-light, gas and street railway franchise to Burdette Loomis and associates. Franchise requires that work shall begin within sixty days. B.

INDEPENDENCE, CAL.—The trustees have granted permission to J. E. Eibeshutz to construct and operate a system of power lines along the public highways of Inyo County. A.

SANTA FE, N. M.—The Montana Power and Irrigation Company has been incorporated at Santa Fe with a capital of $100,000 by G. F. Flick, F. C. Wilson and J. A. Massie. A.

LOS ANGELES, CAL.—The city council has fixed the date for the bond election for voting $3,500,000 for the development of the Owens River power and $3,000,000 for harbor improvements on February 16. A.

SENOIA, GA.—W. B. Baggarly, H. L. Ware, A. O. Baggarly, J. A. McKnight and others are organizing a company to establish and operate an electric-light plant and will at once petition the city council for franchise. B.

SYRACUSE, N. Y.—The Union Realty Company has obtained a permit for the erection of a lighting and power plant to cost $5,000. Current for power and lighting is to be supplied to several of the down town buildings.

SALT LAKE CITY, UTAH—Contracts amounting to over $27,000 have been awarded for the installation of the new lighting system at Fort Douglas. The plans include the lighting and wiring of all quarters and grounds and the erection of a substation.

GADSDEN, ALA.—The grading for the steel plant extension of the Alabama City, Gadsden and Atalla Railroad Company's line has been completed. This new electric line will extend from Forest Avenue, Gadsden, to the new plant of the Southern Iron and Steel Company. B.

LONG BEACH, CAL.—The Long Beach Electrical Company has been incorporated in this city with a capital of $10,000 by Geo. D. Sweetland, M. L. Gunsel and Bernard Gunsel. The company will engage in a general electrical business in this city and surrounding towns. A.

POMONA, CAL.—If the plans of the city trustees are carried out Pomona will have one of the finest street lighting systems in the West. Steel ornamental arches will be constructed across the streets at regular intervals by the property owners, and the city will pay for the cost of lighting. A.

NEW MILFORD, CONN.—It is reported that Verton P. Staub and E. J. Emmons, representing a party of local business men, have purchased the plant of the New Milford Eectric Light Company. The plant was formerly owned by Mrs. W. G. Black, Levi P. Giddings and L. F. Curtiss of New Milford and the price paid is said to have been about $75,000.

CINCINNATI, O.—Plans have been submitted for the heating, electric-light plant in this city. At a recent meeting the following group of the new city hospital. Director Small approved the plans and will advertise for bids for installing the power plant at the earliest possible moment. This power plant will furnish heat and light and power for the entire group of buildings at the hospital.

PARKERSBURG, W. VA.—This city has been considering the installation of an electric-light plant in connection with the water works, and to that end has had estimates prepared. In the report submitted to the Board of Affairs, $41,000 was given as the cost of construction of the plant and the annual charges, including depreciation, are fixed at $9,660.

BENTLEYVILLE, PA.—The Bentleyville Electric Light and Power Company has organized for the purpose of constructing an electric light plant in this city. At a recent meeting the following officers were elected: President, Charles F. Fisher, Pittsburg; secretary, Dr. E. E. Franch, Ellsworth; treasurer, J. G. McCormick, Bentleyville; manager, Nichol Veeser, Bentleyville.

COBALT, ONT., CANADA.—The Nova Scotia Silver Cobalt Mining Company is putting in a mill equipment on its property. It has recently placed an order with the Allis-Chalmers Company of Milwaukee for complete machinery for a twenty-stamp cyanide plant. This plant consists of twenty 1,500-pound stamps, crushing machines, conveyors, tube mills, and cyanide appliances. All machinery is equipped with electric motor drive.

JACKSON, GA.—The Schott Engineering Company, of Chicago, is now engaged in building the transmission lines from the big power dam on the river to Macon and adjacent points. Steel towers will be erected at a cost of $500 each. It will cost $75,000 to build the transmission lines into Macon. The first line will be run from the dam on the Ocmulgee river through Bibb via Indian Springs and Forsyth into Macon. From Forsyth a line will be run to Griffin and Atlanta.

DENVER, COLO.—Plans have been completed for the reorganization of the Southern Colorado Power Company, taking it out of the hands of a receiver. A new company will be organized, with a capital stock of about $5,000,000, the bonded debt of the old company be paid off, and $1,000,000 be spent on extensions and improvements. The company operates the street railway, gas and electric-light and power systems in Trinidad and furnishes power to manufacturing plants. Funds for paying off the indebtedness have been arranged for. The property will be sold at auction next month and purchased by the stockholders.

MONTPELIER, IDAHO.—The Bear Lake Power Company is adding to its generating facilities. The water is delivered through a pipe line 1,500 feet long with a diameter varying from 40 to 36 inches. There will be installed the following equipment: One hydraulic turbine operating under an effective head of 350 feet delivering 920 horsepower normally and a maximum of 1,180 horsepower. The turbine will be direct connected to a 650-kilowatt, 6,600-volt, sixty-cycle, three-phase generator and governor by an oil-pressure governor. Excitation will be provided by means of a fifteen-kilowatt, 120-volt belted exciter. All the generating equipment will be supplied by the Allis-Chalmers Company, of Milwaukee, Wis.

NIAGARA FALLS, N. Y.—The Niagara, Lockport & Ontario Power Company has closed a contract with the American Locomotive Company to supply power to the latter company's works at Dunkirk, N. Y. Delivery will be made over the power company's transmission lines to Lackawanna and from Lackawanna to Dunkirk over the lines of the Buffalo & Lake Erie Traction Company, which is also a customer of the power company. In addition, the Niagara, Lockport & Ontario Power Company's contract with the Buffalo, Lockport & Rochester Railway has been extended from three to twenty-five years in conjunction with an arrangement by which the power company will use the railway company's 60-000-volt line from Lockport to a point within six miles of Rochester. This line will enable the power company to serve a large number of towns along the line of the railway, including Middleport, Medina, Albion, Holley, Brockport and Spencerport, and will also form a valuable auxiliary to the transmission lines of the power company between Lockport and Rochester.

RAMONA, S. D.—The Citizens' Light and Power Company has let the contract for installing a $2,000 electric-light plant, to H. P. Mortenson, of Toronto, S. D.

DOMINION, N. S.—The work of installing the electric-light line has commenced, and the city will in the future receive power from the Sydney and Glace Bay Railway Company. The entire cost of construction will be about $3,000.

MILTON, PA.—The Milton Electric Light and Power Company was sold to Whitacker & Deal, of Harrisburg, and they in turn have sold the franchise for lighting to Philadelphia capitalists, who will build a new high-tension power plant and reconstruct the whole system.

JACKSON, MISS.—New York capitalists are negotiating for the purchase of the Jackson Electric Light, Power and Street Railway and the Jackson Gas-Light Company, owned at present by S. T. Carnes and associates, the properties being estimated at one million dollars. The prospective purchasers will have representatives on the ground shortly to examine the properties, it is understood. L.

ROME, GA.—The Stewart-Morehead Company, of Savannah, has purchased the plant of the Raccoon Cotton Mills, at Raccoon, north of Rome, and a stock company will be formed to carry out the company's plans to develop an available waterpower, where electricity will be generated to run the mill, and to sell to nearby towns and consumers for lighting and other purposes. The machinery of the Raccoon mills will be changed, the plant calling for a 5,000-spindle mill.

JACKSON, GA.—Construction work on the transmission lines of the Central Georgia Power Company on the Ocmulgee River, is now under full headway, the Schott Engineering Company, Chicago, Ill., having an adequate force of men in the field to push the work. Right-of-way through several counties to Macon has been secured, 100 feet in width, steel towers to be erected at a distance of 500 feet. The lines to Macon will be completed possibly by the first of the new year. L.

WILMINGTON, N. C.—The satisfactory results derived from the system of lighting the streets by arches, in which were set tungsten lights, during the Taft celebration in November, have induced the city to extend the system, so that the down-town section will be included, and an average of four arches to the block will be used. The material for the new arches has been ordered and by the first of the new year Wilmington will lay claim to being the best-lighted city in the South, with the exception of Atlanta. L.

RICHMOND, VA.—Upon the recommendation of the finance committee of the city of Richmond, the Common Council in regular session has voted an additional sum amounting to $65,000 to be used in the construction of the distributing system of the new municipal electric lighting plant, now in course of completion. This is in addition to $250,000 bonds, the proceeds of which are for paying for the electric light plant proper, and $100,000 for water pumps to be electrically-driven by power from the new power house. At the same meeting several minor contracts for parts of the electric system were approved. The total thus far authorized is $415,000. L.

ELECTRIC RAILWAYS.

(Special Correspondence.)

SIOUX FALLS, S. D.—It is expected that an electric line will be constructed next year to Bridgewater. C.

WAVERLY, IOWA.—Surveyors for the Waterloo, Cedar Falls & Northern Railway are running a line to Denver Junction. C.

IOWA CITY, IOWA.—The Iowa City, Ottumwa & Southwestern Electric Railway Company, of Pierre, S. D., has been incorporated to construct an electric line to Ottumwa. C.

LAUREL, MONT.—French and New York capitalists, represented by Daniel Giles, are considering the construction of an electric line to Red Lodge at a cost of $3,000,000. C.

MILWAUKEE, WIS.—It is proposed to grant the Milwaukee Electric Railway and Light Company the privilege to build a $50,000 terminal in the southwest corner of the state fair park. C.

FOSTORIA, O.—A new electric line is being planned to run to Paulding, and may be in operation by summer. The work will be pushed as rapidly as possible as soon as the right of way is secured.

DENVER COL.—The Denver City Tramway Company has begun improvements that will involve an expenditure of $1,000,000. Work has already been begun on a system of terminal tracks leading to the round houses. Two office buildings and a two-story interurban depot will be under way in a short time.

GREENFIELD, IND.—A company of capitalists headed by Perry J. Freeman is considering the construction of an interurban electric road between this city and Pendleton, a distance of sixteen miles.

LIMA, O.—The work of electrifying the Columbus & Lake Michigan Railway between Lima and Defiance, Ohio, has been started and it is expected that electric cars will be in operation by January 1. The road is owned by the Ohio Electric Railway Company, of which W. Kelsey Schoepf is president.

RED LODGE, MONT.—An electric line between Laurel and this city is under consideration, and Billings, Mont., is ready to subscribe $25,000 to that end. The rest of the necessary amount, $35,000, is to be raised in Carbon County.

UTICA, N. Y.—The Utica Southern Railway Company has been authorized by the public service commission to build a twenty-seven mile extension of its trolley line, from Hamilton, Madison County, to Norwich, Chenango County, through Earlville and Sherberne. The company is authorized to issue $628,000 bonds and $400,000 preferred stock.

BUTTE, MONT.—The St. Anthony Light and Power Company, a Montana corporation operating in Idaho, has transferred its stock to a new corporation called the Idaho Power and Transportation Company. The transfer includes all the stock and $50,000 in bonds, the consideration for the stock being $20,000 in cash and seven notes of $10,000 each, bearing six per cent interest.

TITUSVILLE, PA.—The Titusville Southern Company has increased its capital stock from $250,000 to $1,000,000. It has also been decided to issue $600,000 worth of bonds. The company, composed of New York capitalists, propose to build a street car line from Titusville to Oil City, and from the size of its capital stock evidently contemplates more road building than that between the two towns.

POTTSTOWN, PA.—To further the building of the proposed Phoenixville, Valley Forge, Strafford & Philadelphia trolley line, a meeting of citizens of the former place was held. About $25,000 stock has been subscribed in that town for the project, and it is stated that there are good prospects for the early building of the line, which would give 30,000 people trolley connections with Philadelphia.

ALLIANCE, OHIO—A merger of Northern Ohio electric railway properties is being talked of, and it is believed that such a combination would put the roads on a better paying basis. The railways which may combine are: Lake Shore; Southwestern; Cleveland, Painesville and Eastern; Western Ohio; Eastern Ohio Traction; Northern Ohio Trolley; Youngstown and Ohio River and Stark Electric.

ALBANY, N. Y.—The Westchester Street Railway Company of White Plains, a reorganization of the former Tarrytown, White Plains & Mamaroneck Railway Company, an electric road, was incorporated recently with a capital of $1,000,000. The directors are Richard Sutre, William Greenough, Charles M. Sheafe, Jr., William L. Barnett, John L. Anderson, Frank F. Hall, Edward O. Brown, of New York; John G. Parker, Augustus S. May, of New Haven, Conn.

CHATTANOOGA, TENN.—The Chattanooga Railway & Light Company has been authorized by the Georgia railroad commission to issue $2,000,000 preferred stock, $3,000,000 common stock and $1,600,000 in bonds. As a part of the lines are in the state of Georgia it was necessary for the company to obtain permission before issuing any stock or bonds. J. C. Lightfoot, secretary and treasurer, appeared before the commission in Atlanta in the interest of the company.

WILMINGTON, DEL.—Thomas E. O'Connell, late president of the West Chester and Wilmington Electric Railway Company, has been elected president of the Phoenixville, Valley Forge and Strafford Electric Railway Company. The company intends to build a trolley road to Valley Forge by way of Williams Corner, along the old Valley Forge dam to Strafford, where direct connection will be made with Philadelphia by way of the Philadelphia and Western Electric Railway. The company has capital of $60,000.

COLONIAL BEACH, VA.—Preliminary steps have now been completed for building four miles of electric railroad between Colonial Beach and Classic Beach, and the Virginia rights for the balance of the line have been granted by the corporation commission of that State. A representative of the company states that it is the purpose of the company to build the road four miles long between the points mentioned and have it in operation by the opening of the season next year.

HARTFORD, CONN.—A special meeting of the stockholders of the Farmington Street Railway Company has been called for December 20 to act on the proposal to sell the company's property, rights and franchises to the New York, New Haven & Hartford Railroad Company. It is expected that the deal will be sanctioned almost unanimously by the stockholders. The company operates an electric road from Hartford to Farmington and Unionville. It has for a considerable time had a traffic alliance with the New Haven road, and has run its cars into the center of Hartford over the trolley tracks of the New Haven system.

GUILFORD, CONN.—The Shore Line Electric Railway Company, which is constructing a line to run along the Long Island Sound shore from New Haven to the Connecticut River and up the river to Essex, has completed deals for four-fifths of the land required and is about to commence the necessary condemnation proceedings to acquire the remainder, which is held at very high prices by its owners. The new trolley line from Guilford east is practically finished and the big power house at Saybrook is about ready for the installation of machinery. It is expected that this portion of the line will be in operation early in the spring and that the connection with New Haven will have been completed by midsummer.

INDIANAPOLIS, IND.—The directors of the Columbus, Greensburg and Richmond Traction Company have elected A. M. Kuhn of this city president of the company and announce that the road will be built next year. S.

CHICAGO, ILL.—The United Railways Company has been incorporated under the laws of Illinois to take over the Consolidated Traction Company. The new company is capitalized at $100,000, subject to a larger issue of certificates, like the Chicago Railway.

STROUDSBURG, PA.—The Delaware Gap Borough Council has granted a franchise to the Stroudsburg & Delaware Gap Street Railway Company to extend its line through the Gap and connect with Portland. This has long been desired for a through line by trolley from Philadelphia to the Gap.

JEFFERSONVILLE, IND.—A mortgage has been filed with the recorder by the Indianapolis & Louisville Traction Company for $600,000 in favor of the Colonial Trust Company of Pittsburg, to guarantee bonds to that amount. The mortgage covers the property of the company from Louisville to Seymour. S.

DANVILLE, IND.—The Terre Haute, Indianapolis and Eastern Traction Company has begun work on the construction of the Danville-Amo extension which will connect with the main line. Bridge material and supplies of all kinds have been distributed and the seven mile link will be rapidly built. S.

RENTON, WASH.—At a meeting of the Valley Improvement Club it was decided to incorporate as the Independent Electric Railway Company for the purpose of building an electric railway from Renton to Kent, along the White River Valley. An estimate fixes the probable cost of construction at $100,000.

YORK, PA.—To offset the shortage of electric power from the York Haven plant, due to the shallowness of the water in the Susquehanna, the Edison Electric Light Company has completed its plant in this city the installation of a 650-horsepower engine and generator. This is counted upon to enable the York Railways Company to restore adequate service.

LAPORTE, IND.—The bonds for the Gary-Hobart-Valparaiso-Laporte traction line, have been sold and there will be no further delay in completing the line. Already considerable grading has been done. This road is being promoted by ex-Senator A. J. Hopkins, of Illinois, and B. A. Mapledoram of New York. This road will connect a large number of thriving towns and cities and with entrance into Chicago will doubtless become a profitable road.

EVANSVILLE, IND.—Charles M. Murdock, of Lafayette, has been elected president of the Evansville & Southern Indiana Traction Company, to succeed H. B. Smith of Hartford City, who died suddenly last September. Mr. Murdock was born in Lafayette in 1868 and succeeded to the traction interests of his father, the late James Murdock. The old board of directors was re-elected. S.

WAYCROSS, GA.—The Burdette-Loomis syndicate has been granted a franchise for the electric, gas and street railway privileges of the city. The work on the plants must be started before the middle of February, and a cash bond of $10,000 binds the company to complete the work as soon as possible. The company is under bond until $100,000 has been put into the combined plants.

LOGANSPORT, IND.—The Logansport & Frankfort Traction Company has been reorganized and merged with the Cleveland Construction Company. The directors announce that the road will be constructed as speedily as possible, and will be known as the "Three C" line because of its crossing Cass, Carroll and Clinton Counties. Substantial subsidies have been voted in aid of the road. W. F. Travis, manager of the Cleveland Construction Company will have charge of the construction work. S.

NEW MILFORD, CONN.—Verton P. Staub and E. J. Emmons, representing a party of local business men have purchased the New Milford Electric Light Company's plant. The plant was formerly owned by Mrs. W. G. Black, Levi P. Giddings and L. F. Curtiss, of New Milford, and the price paid is said to have been about $75,000. Heretofore the company has furnished lighting service only. The new owners are planning to run the plant day and night and sell electricity for both light and power.

OKLAHOMA CITY, OKLA.—The contracts for the grading and bridge work were closed Wednesday by the Oklahoma Railway Company for the construction of a new interurban line between Capitol Hill and Moore, seven miles south of Oklahoma City. The construction will be continued from the terminus of the company's Capitol Hill line at the south end of the Shield's Oklahoma addition. Vice-President John W. Shartel announces that the road will be graded and ready for track in a short time and cars will be running by June 1.

RICHMOND, VA.—The sum of $600,000 will be expended in general improvements by the Virginia Railway and Power Company, of Richmond, according to an announcement made public by President Northrup, in Richmond. In the budget of expenditures made possible by this sum of money, is included a new terminal station in Manchester, across the James River from Richmond, and the putting on of new high-speed motor equipment for the Richmond-Petersburg thirty-mile interurban line, with terminals in Manchester.

CENTERVILLE, IOWA.—Local capitalists have become interested in the construction of a line which will probably run from Sioux City to Mitchell, S. D., through Centerville, S. D., Menno and Olivett. L. F. Phillips of Wagner, S. D., formerly a resident here, has been in consultation with influential men of this section and has a company organized to back the enterprise. The plan will be to have the people along the line subscribe for a six per cent bond issue, secured by the property of the company, subscriptions to be payable to designated trustees and the road to be completed by Jan. 15, 1911.

ANDERSON, S. C.—The property of the Anderson Traction Company has been bought by a syndicate, composed of the Dukes and several prominent citizens of the Piedmont section of South Carolina. Announcement is made by a committee representing the syndicate that it is the intention to extend the Anderson-Belton line from Belton to Greenville, and as soon as that is completed a line will be built from Greenville to Spartanville, and ultimately the line will be extended to Greensboro via Charlotte. It is also stated that the line will be extended southward from Belton to tap the Seaboard Air Line, probably at Abbeyville. A freight service will be given as well as a passenger service, and the line will compete with steam lines. Thus Anderson and Greenville will be given close connection with the Carolina, Clinchfield and Ohio Railroad at Spartanburg, and with the main line of the Seaboard Air Line.

MADISON, WIS.—The Cincinnati Construction Company, recently incorporated to build an interurban line between Madison and Janesville, has made application to the state railroad commission through their attorney, John A. Aylward, for a certificate of conveyance and necessity to lay and operate an electric road between Madison and Janesville, a distance of about 35 miles. An amendment changing the company's offices from Janesville to Madison has also been filed. The route of the proposed road is as follows: Leaving the city limits of Janesville, it will go through the towns of Edgerton and Stoughton, then follow the southern shore of Lake Kegonsa, along the southern end of Lake Waubesa, and thence on to Madison, where it will connect with the tracks of the Southern Wisconsin Railway Company, by which it will enter the city. It is said that the right-of-way of about half the route has been secured and options are held on the remainder of the distance. The company has filed with the railroad commission a map showing the quarter sections through which the surveyed route will pass, and the drainage accommodations. Attorney Aylward states that work will be started as early as possible in the spring and that a large part of the construction material has been contracted for. President Zigler, of the Cincinnati Construction Company, says that no bonuses are to be asked for along the line. This electric road will give Madison interurban connection with Chicago, by the Rockford and Interurban Railway Company's line from Janesville to Rockford, through Beloit. M.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

OMAHA, NEB.—The fire and police board recommend the letting of a contract to the Nebraska Telephone Company for the installation of a fire and police alarm system.

FLORENCE, COL.—After a delay of several weeks, work has been started on the installation of the new telephone system of the Colorado Telephone Company. The new improvements will entail an expenditure of about $20,000.

DECATUR, ARK.—The Decatur Mutual Telephone Company, of Decatur, has filed articles of incorporation, the capital stock being placed at $10,000, of which $5,000 is subscribed. The incorporators are: H. E. Clark, president; J. N. Oglesby, vice-president; J. Burkhardt, secretary; W. S. McGaugh, treasurer; J. F. Dorsett, R. E. Lee and E. M. Plank.

COLUMBIA, LA.—The Home Telephone Company, of Monroe, which recently established an exchange in Columbia, is extending its lines from this point in the direction of the home office, and will connect with Monroe lines in the near future. The line is already in operation as far as Riverton and is being rapidly pushed forward.

TACOMA, WASH.—It is stated that the Pacific Telephone and Telegraph Company will expend $500,000 in improvements during the coming year in this district. C.

GRAND FORKS, N. D.—The Grand Forks and Brenna Rural Telephone Company, Julius Berg, Brenna Township, secretary, has been organized to construct rural lines to connect with the Northwestern Telephone Company. C.

ANGELICA, N. Y.—The residents of Barber and Taylor Hill, near Rushford, have organized what is known as the Barber and Taylor Hill Telephone Company, an independent company, which will connect with the switchboard of the Rushford Telephone Company's exchange, with the same rights and privileges as other subscribers. The contract has been let for the construction of the line, which will be rushed to completion. The following persons are officers of the new company: E. M. Olney, president; Howard Luce, vice-president; William Barber, treasurer; R. A. Taylor, secretary.

THOMAS, OKLA.—The Farmers' Telephone Company has been incorporated with a capital stock of $5,000. P.

WASHBURN, N. D.—The Independent Telephone Company will build a line to Stanton. Heavy copper wire will be used . C.

WABASHA, MINN.—The Dwelle Telephone Company is making plans for the installation of a new telephone system. C.

MANDAN, N. D.—The North Dakota Independent Telephone Company is to expend $50,000 in constructing new lines.

TULSA, OKLA.—The Calumet Western Telephone Company has been incorporated with a capital stock of $25,000. P.

MILES CITY, ONT.—The Tongue River Telephone Company has been incorporated to construct and operate a rural line to Ashland. C.

DILLON, MONT.—The Independent Telephone Company has been incorporated with a capital of $1,500,000 and will install an exchange here.

BROOKINGS, S. D.—The Brookings County Telephone Company has been incorporated to succeed the Thompson, Caldwell & Wilson Telephone Company.

SAN FRANCISCO, CAL.—The Pacific Telephone Company had on October 1 a total of 349,119 telephone stations, an increase since the first of the year of 31,607 stations or very nearly ten per cent.

RAPID CITY, S. D.—It is expected that the line of the Black Hills Independent Telephone Company will be completed and be installed and in operation by April, 1910. The company is capitalized at $50,000.

LOUISVILLE, KY.—The Central Home Telephone Company, owning lines and exchanges in Kentucky and Southern Indiana, has been sold for $250,000 to E. H. Cady, representing bondholders of Toledo, O.

SALUDA, S. C.—The Delmar Telephone Company has contracted with the Saluda exchange for the construction of a metallic circuit to unite the two systems, enlarging the service available to clients of both exchanges. L.

BELLEFONTAINE, O.—At a recent meeting of the United Telephone Company, of this city, the stockholders voted to increase the stock from $300,000 to $1,000,000. This is done presumably to strengthen the company in its fight against the Bell interests.

ASBURY PARK, N. J.—It is reported that the New York and New Jersey Telephone Company is to erect a modern three-story building in which to install its telephone exchange. The building will also contain the business offices and is to be the district headquarters of the company.

NEW ORLEANS, LA.—A new exchange is being built by the Cumberland Telegraph and Telephone Company in New Orleans, and will be designated as the "Walnut" exchange, with between seven and eight hundred subscribers. The exchange is located at at the corner of Burdette and Zimple Streets. L.

PORTLAND, ME.—The New England Telephone and Telegraph Company is laying an armored cable from Fish Point to Peak's Island, a distance of about three miles. It is estimated that the cable, together with the cost of installation, will cost about $15,000.

SPENCER, N. C.—An effort is being made to secure a franchise for a telephone system in Spencer, and the Merchants' Association has passed a resolution favoring the Bell Telephone Company, on account of its extensive outside connections. Representatives of the Lexington, Concord and Statesville systems are endeavoring to secure the Spencer franchise. The Bell Company already has the field partially covered. L.

MISHAWAKA, IND.—A meeting of the directors of the Home Telephone Company operating in this city, South Bend and surrounding community was held in this city December 2. The work of the year just closing was reviewed and plans made for considerable improvement, extensions, etc., for the coming year. The business session was followed by a banquet at the Mishawaka Hotel. S.

WEST POINT, IND.—The West Point Co-operative Telephone Company has incorporated to build, equip and operate a telephone exchange in West Point, with telephone lines radiating throughout Tippecanoe, Fountain and adjoining counties. L. J. Clemment, J. C. Whitehead, J. F. Martin, Benjamin Turner, S. R. Stover and Charles Turner, directors. This company is in the market for material and equipment for the construction of a new plant. S.

CRAWFORDSVILLE, IND.—There are strong indications that a deal has been made for the consolidation of the two local telephone companies operating in this city. The plan which seems to be borne out by the circumstantial evidence is for the Home Company to take over the Bell Company's local plant and presumably the long-distance business be turned over to the Bell Company. In any event the Home Telephone Company is preparing to build a complete county system and will construct many new lines next year. S.

NEW YORK, N. Y.—The Continental Telephone and Telegraph Company has acquired by purchase the control of a majority of the common and preferred stock of the American Union Telephone Company of Pennsylvania, an independent telephone company operating a system throughout the entire State of Pennsylvania, except the cities of Philadelphia and Pittsburg. The system also covers a part of New York, West Virginia, Maryland and Delaware. It has upward of 20,000 miles of wire, 65,000 subscribers and 243 exchanges. It is understood that with the acquisition of this property the Continental will immediately begin the construction of a new long-distance line from Pittsburg to Harrisburg, the Pittsburg and Alleghany, of Pittsburg, being also controlled by the Continental. At a meeting of the directors recently held the following officers were elected: John A. Howard, president; Samuel W. Harper, vice-president; Charles West, second vice-president; S. R. Caldwell.

FORT VALLEY, GA.—Two telephone companies, the Fort Valley, whose franchise expired four years ago, and a new concern, the Fruit Belt Company, are seeking a franchise in Fort Valley, the former company claiming that under its original franchise it is entitled to a renewal. The new company, owned by Max L. James and associates, in the meantime, has secured a franchise from the town, and has material ready for construction work. The old company, being ordered to remove its poles and wires, secured an injunction to prevent the Fruit Belt Company from interfering with its work, and restraining the town from injuring its business, and asking $5,000 damages for what has transpired. The Fort Valley Company alleges that the city's electric light wires have interfered with its telephone service, and for this and other reasons alleged, the $5,000 damages are sought, and a heated contest is developing. L.

ELECTRICAL SECURITIES.

Since the issuance of the presidential message and the assurance that nothing alarming was contained therein, the market has assumed an aspect which is notably for the better. All have agreed that there must be more definite understanding between the law and the corporations, which if it cannot be brought about by a change in the corporation management, may be effected by changes in the law. At any rate stockholders are assured that there will be but little disturbance, and their feeling of security is reflected in the upward trend of the market.

The increase in the gross earnings of Brooklyn Rapid Transit during November is being continued. For the first week in December the average daily increase in gross was over $6,000, compared with an increase of slightly better than $5,000 last month. In the fiscal period from July 1 to December 4, gross earnings of the company were $9,129,025, an increase of $844,438, or nearly twelve per cent.

The directors of the Philadelphia Company have voted to offer the preferred and common shareholders of record at close of business December 18, the privilege to subscribe at par to 55,200 shares, of the par value of $50 each, of the common capital stock of the company, authority for issue of which was given on August 14, 1906. The privilege to subscribe terminates on December 30, and payment in full for said shares is to be made at the office of the treasurer of the company in Pittsburg, or at the office of the New York Trust Company, 26 Broad Street, New York, on January 3, 1910. The entire new issue has been underwritten by Ladenburg, Thalmann & Company, and the Swiss Bankverein, of London.

DIVIDENDS.

American Telephone and Telegraph Company; quarterly dividend of two per cent, payable January 15.

Butte Electric and Power Company; quarterly dividend of one and one-half per cent, payable January 3.

Duluth-Superior Traction Company; quarterly dividend of one per cent on common, payable January 3.

Electric Securities Corporation; semiannual dividend of four per cent on common, payable January 3.

Manhattan Railway; quarterly dividend of one and three-fourths per cent, payable January 1.

Sao Paulo Tramway; quarterly dividend of two per cent, payable January 3.

Toronto Railway Company; quarterly dividend of one and three-fourths per cent, payable January 3.

Twin City Rapid Transit Company; quarterly dividend of one and three-fourths per cent, payable January 2.

Union Traction Company, of Philadelphia; semiannual dividend of $1.50, payable January 1 to stockholders of record December 10.

United Gas Improvement Company; quarterly dividend of two per cent, payable January 15.

United Traction and Electric Company; one and one-quarter per cent, payable January 1.

Western Union Telegraph Company; quarterly dividend of one and three-quarter per cent, payable January 15.

Wilkesbarre Gas and Electric Company; quarterly dividend of one and three quarter per cent, payable January 1.

The New York State Public Service Commission, Second District, has authorized the Northern Westchester Lighting Company of Ossining to issue $124,000 five per cent gold bonds maturing June 1, 1950. The bonds are to be sold at not less than ninety per cent of their par value.

NEW YORK.

	Dec. 13.	Dec. 6.
Allis-Chalmers common	15⅛	15¾
Allis-Chalmers preferred	54	54¾
Amalgamated Copper	86⅞	87⅞
American Tel. & Cable	*80	*80
American Tel. & Tel.	142⅞	140¾
Brooklyn Rapid Transit	80¼	80⅞
General Electric	160¼	159
Interborough-Metropolitan common	24½	24⅝
Interborough-Metropolitan preferred	61¾	57¾
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	91¼	92
Mackay Companies (Postal Telegraph and Cables) preferred	76¼	76½
Manhattan Elevated	140¼	139¾
Metropolitan Street Railway	20	20
New York & New Jersey Telephone	123½	123½
U. S. Steel common	90⅞	90¾
U. S. Steel preferred	125½	124½
Western Union	77¾	77¾
Westinghouse common	84½	84½
Westinghouse preferred	130	140

*Last price quoted.

BOSTON.

	Dec. 13.	Dec. 6.
American Tel. & Tel.	142⅞	140¾
Edison Elec. Illuminating	...	249
General Electric	160¼	159
Massachusetts Electric common	15	15½
Massachusetts Electric preferred	76	76¼
New England Telephone	135½	134
Western Tel. & Tel. common	12	12⅛
Western Tel. & Tel. preferred	89½	89

PHILADELPHIA.

	Dec. 13.	Dec. 6.
American Railways	45¼	45
Electric Company of America	12¼	12½
Electric Storage Battery common	57	56½
Electric Storage Battery preferred	57	56½
Philadelphia Electric	13½	12⅛
Philadelphia Rapid Transit	28¼	27½
Philadelphia Traction	88¾	88½
Union Traction	52½	52½

CHICAGO.

Chicago Railways, Series 1	95	95
Chicago Railways, Series 2	30½	31
	Dec. 13.	Dec. 6.
Chicago Subway	4¾	5¼
Chicago Telephone	135½	135
Commonwealth Edison	117½	118
Metropolitan Elevated common	16½	16½
Metropolitan Elevated preferred	53	51½
National Carbon common	102½	97¼
National Carbon preferred	123	120

PERSONAL MENTION.

J. DINSMORE, technical engineer of the Excello Arc Lamp Company, of New York, visited the Chicago office of the company last week.

M. A. GURNEY, who formerly represented the Tungstolier Company in Iowa and the central western states, has been made manager of the Chicago office of that company.

CAPTAIN WILLARD L. CANDEE, president of the Okonite Company, of New York, is drinking the waters at Mt. Clemens, Mich., and enjoying a few weeks' rest.

F. X. CLEARY has assumed the duties of advertising manager of the Western Electric Company, succeeding H. M. Post, who is no longer connected with the company.

J. M. GEORGE has resigned his position as manager for the Southern Bell Telephone and Telegraph Company at Tifron, Ga., to accept the position as chief engineer for the electric-light and water works plant at Moultrie, Ga.

JESSE W. UNDERWOOD, for several years connected with the New York office of the Cutler-Hammer Manufacturing Company, has accepted a position in the Securities Department of Stone & Webster, and will hereafter reside in Boston.

ANDREW CARNEGIE has donated the sum of $100,000 to the Iron and Steel Institute of Great Britain to endow a research scholarship for the purpose of enabling qualified students to conduct researches in the metallurgy of iron and steel.

RICHMOND E. SLADE, for six years treasurer and general manager of the Hartford City Gas Light Company, has resigned his offices, to become general manager of the gas and electric departments of the New Orleans Railway and Light Company, New Orleans, La.

CAPTAIN ROALD AMUNDSEN, discoverer of the Magnetic North Pole, and the first man completely to navigate the Northwest Passage, will, on his voyage of exploration to the Arctic next summer, make magnetic observations for the department of terrestrial magnetism of the Carnegie Institution of Washington.

STEPHEN D. FIELD, the eminent electrical engineer and inventor, was a New York visitor recently from his home in Stockbridge, Mass. Mr. Field's new quadruplex system has recently been put in practical operation over the Western Union Telegraph Company's Havana-Key West cable, and its application has considerably increased the efficiency of the service.

W. C. WEBSTER, manager of the Westinghouse Electric and Manufacturing Company's office in New York city, has resigned his position and will probably terminate his connection with the company about the first of the year. Mr. Webster's experience with the Westinghouse interests have been quite varied and extensive for the past twelve years. His first position was in the sales department at East Pittsburg. He later became assistant vice-president with headquarters in New York, and for the last few years has been the New York manager, having in charge the New York end of the company's business. Mr. Webster, as yet, has made no plans for the future.

DR. R. T. GLAZEBROOK, director of the National Physical Laboratory, Teddington, Middlesex, England, has been awarded the Hughes medal of the Royal Society of London for his researches on electrical standards. Doctor Glazebrook is a past-president of the Institution of Electrical Engineers, London, England, and was formerly principal of the University College of the Victoria University, now Liverpool University. He is one of those true men of science who labor more for the love of their work than for mere monetary reward, for it is a well-known fact that Director Glazebrook could have positions which carry much higher salaries than are paid at Bushy House. It is particularly pleasing, therefore, to be able to record another honor that has been so deservedly given to this eminent physicist and electrician.

FRANK L. PERRY, for many years on the staff of the WESTERN ELECTRICIAN, and well known among the electrical men of the country, has added another exploit to his many victorious achievements. As special representative of the Chicago Electrical Show management, he has prevailed on Uncle Sam's officials in the War Department to exhibit the Wright aeroplane as one of the striking features at the Coliseum next month. The amount of diplomacy and tact that were needed to secure this consent can hardly be imagined, but Mr. Perry's persistency and resourcefulness won out in the end, after he had, with the aid of several Chicagoans, appealed to the President of the United States. Mr. Perry's special study of wireless telegraphy in connection with aeroplanes served him materially in his mission to the powers at Washington.

NEW PUBLICATIONS.

PROCEEDINGS OF THE MICHIGAN ELECTRIC ASSOCIATION—The proceedings of the sixth annual convention of the Michigan Electric Association have been published in book form. The convention was held in Detroit on August 17 to 19 last. The bound volume of the proceedings, consisting of 126 pages, gives in full all of the papers presented and the discussions on them. Reports of the various committees are also included.

PROCEEDINGS OF THE OHIO ELECTRIC LIGHT ASSOCIATION—The Ohio Electric Light Association has published in book form the proceedings of its fifteenth annual convention that was held at Toledo, O., on July 13, 14 and 15, last. This book of 134 pages gives in full all the papers that were presented with the discussions upon them. A membership list of the association is also included, as well as a full list of the officers and committees.

IRON ORE DEPOSITS IN CANADA.—This report on the iron-ore deposits along the Ottawa and Gatineau rivers, in Canada, by Fritz Cirkel, M. E., has recently been published by the Mines Branch of the Canadian Department of Mines. After describing in detail various iron-ore deposits in the townships of Hull, Templeton, Wakefield, Bristol, Grenville and others, Mr. Cirkel concludes that many of these would yield ores which could in all probability be treated profitably in the electric furnace. It is stated in the report that this mehod of reducing the iron ores can compete with the blast furnace for the production of pig iron, when electrical energy can be developed at a low cost. An appendix to the report gives a synopsis of the waterpowers, both developed and undeveloped, in the region under consideration. These data have been compiled from the latest authoritative sources available. The report is well illustrated.

PROCEEDINGS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION—The complete proceedings of the thirty-second convention of the National Electric Light Association, which was held at Atlantic City, N. J., June 1, 2, 3 and 4, 1909, have been published in book form and constitute three bulky volumes comprising nearly 2,300 pages. The first volume is devoted to the general sessions and contains all of the papers, reports and discussions that were presented at these meetings. It also contains a complete list of the membership in the various classes as it existed at the time of the convention. The second volume contains the full proceedings of the technical and commercial sessions. The third volume gives in detail the proceedings of the accounting sessions and of the executive sessions, including in the latter the full reports of the executive and public policy committees. Each of the volumes also contains a very excellent author index and synopsis of the papers that were presented. The great bulk to which the annual convention proceedings of the association have grown is an excellent indication of the growing importance of the association and of the rapid extension of its work. The papers and reports that were presented, with discussions, make these volumes the most complete and up-to-date publication in book form of the central-station industry.

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has recently received an order from the Bear Lake Company, of Montpelier, Idaho, for twenty-six transformers varying in size from two to 100 kilo-volt-amperes.

THE NATIONAL-ACME MANUFACTURING COMPANY, Cleveland, Ohio, is mailing samples of a steel stud of special form, which, it is claimed, was made on an Acme automatic screw-machine in twenty-five seconds and with less than seven seconds of labor.

THE FANCLEVE SPECIALTY COMPANY, Jamaica Plain, Mass., manufacturers of fittings for conduit, cable and molding construction, is distributing a very attractive calendar for the year 1910. The calendar contains a reproduction of a painting, entitled "The Trail of Sunset."

GEO. CUTTER, South Bend, Ind., is distributing a circular devoted to a number of specialties, among which are streethood sockets with a two-story flange for use with deep top and shallow top hoods; spring suspended sockets for delicate filaments; many-light hoods; tungsten streethoods and tungsten street brackets.

THE ARNOLD COMPANY, 191 La Salle Street, Chicago, Ill., is mailing an interesting postal card, showing views of the Burnside Foundry Plant of the Featherstone Foundry and Machine Company. These four pictures are illustrative of some of the best features of the plant, which was constructed by this well-known engineering firm.

HUBBARD & COMPANY, Pittsburg, Pa., have recently distributed a booklet devoted to transposition methods. Taking the view that the transpositions of toll lines must be mechanically strong, must take account of possible breakages of insulators, loosening of tie wires, etc., in addition to being electrically correct, this booklet shows diagrammatically the proper transposition of toll lines, and describes and illustrates the apparatus for accomplishing this.

THE TOLTEC PORTLAND CEMENT COMPANY, of Kansas City, Mo., has ordered from the Allis-Chalmers Company, of Milwaukee, the following induction motors and equipment for its plant at Hidalgo, Mex.: Five 150-horsepower motors of special design for driving tube mills, two 150-horsepower motors to be belted to line shafts, two 110-horsepower motors for pulverizers, three smaller belted motors and one complete twenty-horsepower single-drum hoist.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has recently distributed a bulletin, No. 371, devoted to adjustable speed motors. This publication discusses briefly the operating characteristics of these motors which are particularly adapted for machine tool operation, and also for other classes of work, such as operating printing presses, pumps, blowers, elevators, etc. In addition to the descriptive matter, several illustrations of Triumph motors driving various machines are shown.

I. P. FRINK, 551 Pearl Street, New York, N. Y., designer and manufacturer of lighting specialties, is distributing booklet No. 59, entitled "Frink's System of Bank Illumination." According to the booklet this system is a practical application of the optical laws governing refraction and reflection. The perfect diffusion eliminates all glare and shadows and the symmetrical appearance obtained is very pleasing. To further emphasize this, the booklet contains views of a modern bank in which the Frink system has been installed.

THE AMERICAN FLAMING ARC LAMP COMPANY, 148 Purchase Street, Boston, Mass., is distributing an attractive catalogue devoted to the "American" flaming arc lamps and a price list of lamps, globes, carbons and repair parts. The former publication contains a detail description of the lamp, including the electrical and mechanical specifications. In addition illustrations showing the various details of construction and the distribution of light. The latter publication contains the latest revised prices on all parts and supplies.

H. G. McFADDIN & COMPANY, 38 Warren Street, New York, N. Y., are distributing two circulars devoted to "Emerald" electric desk and piano lamps. The desk light reflector is constructed so as to distribute light over the entire desk. The supporting arm is easily adjustable to the various widths of desk tops and the clamps are felt lined. The piano lamp is equipped with an ornamental base which holds the lamp securely. Both lamps are of standard finish and the illustrations contained in the booklets show the various styles of these lamps.

THE DIAMOND RUBBER COMPANY, Chicago, Ill., announces that its complete stock of rubber covered wires and cables which has been carried for some time by its branch, located at 211 Lake Street, has been transferred to the regular Chicago Branch of the company, located at 1523-31 Michigan Avenue, Chicago. This stock includes practically the complete line—thirty per cent para, red core and black core, lead encased cables, igniter cables, etc. W. I. Morrow, formerly of the Akron office, is in charge. Prompt shipments can be made direct from Chicago.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a new twelve-page booklet, entitled "Holiday Suggestions." This booklet describes a complete line of Christmas-tree outfits, toys, vibrators, electrical heating devices, etc. A new folder sent out by the same company deals with the Pittsburg type transformer fuse block for use on 2,200-volt circuits. This folder should be found of considerable service to central station managers in that it gives the proper size of fuses to be used with diffierent sizes of transformers at both 1,100 and 2,200 volts.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is distributing the December issue of *The Emerson Monthly*, which contains, *inter alia*, a description of the Perry electro-pneumatic, water-supply system, and a remarkable offer to send samples of the Emerson type 732 D A motor (one-half horsepower ventilated direct-current motor), in regular stock winding on thirty days' trial to responsible electrical dealers and central stations anywhere in the United States. Such samples are subjected to return in good condition for full credit, if returned promptly at the end of the trial period.

THE PETTINGILL-ANDREWS COMPANY, Boston, Mass., has just distributed the December issue of "Juice," its monthly publication devoted to electrical material. This number is an exceptionally interesting one, containing descriptions and illustrations of numerous electrical devices for Christmas. Special space has been given electrical toys and miniature fruit and flower electric lamps for decorating purposes. In addition to the foregoing this publication contains an interesting editorial entitled "Spilling Tea," and an interesting and instructive article by G. E. Palmer entitled "The Factors of Economical Meter Testing."

THE SPRAGUE ELECTRIC COMPANY, New York, N. Y., is distributing a bulletin known as No. 110, devoted to continuous current direct-driven, type S generators for lighting and power. A distinctive feature of these machines is the use of a soft steel casting for the magnetic yoke, the generators having been designed so as to use to advantage the superior magnetic qualities of steel. The bulletin describes the design and construction of the type S generator in detail and contains, in addition to illustrations of the various details of the machine, several views of these generators installed in prominent power plants.

THE PARTRICK, CARTER & WILKINS COMPANY, of Philadelphia, Pa., the old-established manufacturer of annunciators, burglar alarms, bells and other electrical house goods, has removed its general offices and salesrooms from Twenty-second and Wood Streets to 122 North Eleventh Street. The factory will remain where it is, and the moving of the offices and salesrooms will give largely increased factory space. Offices and salesrooms will now be more centrally located for the convenience of architects and others who desire to show the apparatus in practical operation to their clients. The firm is also selling agent for the line of fire alarms, district boxes, etc., made by the Viaduct Electric Company.

THE DIELECTRIC COMPANY OF AMERICA, Belleville, N. J., is distributing an attractive catalogue entitled "New Ideas in Underground Transmission." This publication describes the Dielectric system of underground transmission for power and lighting circuits, which consists of a wooden box or trough, in which the conductors are supported on special porcelain insulators and surrounded with a special "Dielectric" compound. It describes in detail the properties of this compound and mentions a few of the many points of merit of the system. Illustrations showing the construction and application of the system are shown. Orders have been placed to double the capacity of the plant as there are sufficient orders on hand to keep the present machinery busy until next October.

THE PARKER-CLARK ELECTRIC COMPANY, of New York city, announces the retirement of W. G. Clark from his connection with the company and the election of Dr. George N. Miller to the office of president and director. In order to be in close touch with the laboratories, the offices of the company have been moved from the Singer Building to the Lincoln Square Building, 1966 Broadway. Prof. H. C. Parker continues at the head of the laboratory work and, with the advent of the new chief executive, active preparations are being made to place the company's products on the market at once. The Helion resistors developed by this company undoubtedly meet a definite need in the electrical heating field. Anticipating a large demand for these resistors, the company plans to start a factory for their manufacture as soon as a suitable location can be selected. Work will also be vigorously prosecuted on the Helion incandescent lamp, which is now nearing perfection, with the idea of offering it to the public this coming spring. The company is also preparing to manufacture immediately the Helion naval lamp to meet the large demand for an incandescent lamp which will stand the shock of firing large guns on board men-of-war. The Helion filament is said to meet these demands admirably; even should the glass globe enclosing the filament be broken, the filament will burn in the open air for an indefinite period without apparent deterioration.

DATES AHEAD.

Chicago Electrical Show, Coliseum, Chicago, January 15 to 29, 1910.

Wisconsin Electrical Association. Annual convention, Milwaukee, Wis., January 19 and 20, 1910.

Toledo Electrical Show, Coliseum, Toledo, Ohio, January 31-February 5, 1910.

San Francisco Electrical Exposition, January 29, February 5, 1910.

Philadelphia Electrical Exposition, Philadelphia, Pa., February 14-26, 1910.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) December 7, 1909.

942,046. PROCESS OF GENERATING AND STORING OZONE. Frank M. Ashley, New York, N. Y. Continuation of application filed September 21, 1905. This application filed December 15, 1906. Oxygen is converted into ozone by an electric treatment in an ozonizer, special precautions being taken to prevent expansion of the product during storage in a suitable receptacle.

942,050. MOTOR-CONTROLLING DEVICE. Thomas E. Barnum, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company. Filed March 14, 1907. Contact segments are carried by each of two insulated drum segments on the controller shaft. Rotation of the shaft causes the contact segments to engage alternately with contact fingers so as periodically to change the circuit connections of the motor.

942,068. ELECTRIC FURNACE WITH RAISED CHARGING-PIT. Alois Helfenstein, Vienna, Austria-Hungary. Filed June 12, 1909. Broad slots or openings in the furnace roof are made gastight.

942,091. HARMONIC SIGNALING SYSTEM. Ray H. Manson, Elyria, Ohio, assignor to Dean Electric Company. Filed February 8, 1906. The effect of the main source of current in an electrical transmission system is accentuated by sharply varying periodic waves of electromotive force impressed on the circuit.

942,110. ELECTRIC FURNACE. Frederick T. Snyder, Oak Park, Ill., assignor to Electric Metals Company. Filed Sept. 25, 1906. Has special cooling features for the walls and electrodes.

942,131. TIME-CONTROLLED SMOKE-PREVENTER. Bradford L. Ames, Boston, Mass. Filed February 28, 1908. A contact device, actuated by a clock train, closes an electric operating circuit at the end of a predetermined time interval.

942,143. CATENARY SUSPENSION SYSTEM FOR THE TROLLEY WIRES OF ELECTRIC RAILWAYS. Kalman von Kando, Vado Ligure, Italy, assignor to George Westinghouse, Pittsburg, Pa. Filed October 2, 1908. An insulator is secured to a supporting arm, and an intermediate member, carried by the insulator, adjustably secures the suspension wire.

942,156. GRID RESISTANCE. Henry J. Wiegand, Milwaukee, Wis., assignor to The Cutler-Hammer Manufacturing Company. Filed March 29, 1909. A reinforcing strip placed over the edge of the grid has portions bent around lugs on the grid to secure it.

942,157. VAPOR ELECTRIC APPARATUS. Howard I. Wood, Schenectady, N. Y., assignor to General Electric Company. Filed January 18, 1904. A mica-supported filament extends between the electrodes.

942,186. MAGNETIC CLUTCH. Henry W. Ravenshaw, Hanwell, England. Filed Feb. 28, 1907. A pinion gears with teeth on the outer ring of an intermediate element consisting of two concentric rings of magnetic material secured together by a flexible ring of nonmagnetic material. The electromagnetic and its keeper are annular in form.

942,187. MAGNETIC CLUTCH. Henry W. Ravenshaw, Hanwell, England. Filed January 14, 1908. Similar to the preceding.

942,188. MAGNETIC CLUTCH OR BRAKE. Henry W. Ravenshaw, Hanwell, England. Filed March 17, 1908. A magnetizing coil surrounds slidably mounted intermediate elements in part mounted on a boss connecting the driving and the driven shaft.

942,195. SIGNAL-CONTROLLING APPARATUS. Winthrop M. Chapman, Needham, Mass., assignor to Electric-Railway Signal Company. Filed April 25, 1908. Contacts are arranged to be closed by the trolley of an electric car, other contacts by the wheels of the car, and a signal-controlling circuit is closed by the closure of both sets of contacts.

942,196. APPARATUS FOR CONTROLLING ELECTRIC MOTORS. Harry E. Dey, Jersey City, N. J., assignor to Ben T. Cable, New York, N. Y. Filed August 6, 1908. The relative strength of the field magnets of two dynamoelectric machines (one with a stationary and a rotary element and the other with both elements rotary and having one rotary element connected mechanically to the rotary element of the first machine) is varied and controlled, and a counter resistance is operated with the load.

942,197. APPARATUS FOR CONTROLLING ELECTRIC MOTORS. Harry E. Dey, Jersey City, N. J., assignor to Ben T. Cable, New York, N. Y. Filed August 8, 1908. In a similar arrangement to the preceding, the series winding of the field magnet of each machine is placed in the circuit of the armature of the other machine.

942,198. APPARATUS FOR CONTROLLING ELECTRIC MOTORS. Harry E. Dey, Jersey City, N. J., assignor to Ben T. Cable, New York, N. Y. Filed May 21, 1909. The relative strength of the field magnets of the various motors to be controlled is varied and controlled by a rheostat operated by a pilot motor. The rheostat is also operated with the load so as to be restored thereby to its normal position.

942,208. DUPLEX CABLE TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa. Filed May 20, 1908. Renewed April 29, 1909. The receiving apparatus comprises a transformer the primary of which is associated with the line and the secondary of which controls the receiving instrument. A third winding on the transformer is associated with the transmitter to neutral the effect of transmitted impulses in the secondary winding.

942,240. PLURAL-LAMP-HOLDING DEVICE. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company. Filed August 5, 1907. Electrical contact and lamp-holding devices are carried by insulating blocks secured respectively to radial legs on the main supporting member.

942,241. PLURAL LAMP-SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company. Filed December 28, 1907. A base carrying an inner contact is removable independently of the outer contacts.

942,242. PLURAL-LAMP-HOLDING DEVICE. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company. Filed December 28, 1907. Each of a number of metallic strips connects mechanically and electrically a pair of sockets.

942,243. METHOD OF MILKING COWS. Franz M. Berberich, Kiel, Germany. Filed November 25, 1908. The flow of milk is promoted by subjecting the cow to a slight electric shock.

942,248. AUTOMATIC SELF-INDICATING FUSE. Frank B. Cook, Chicago, Ill. Filed March 1, 1909. Fusing of the conductor releases a coil spring which operates a plunger.

942,264. BRUSH-HOLDER. Austin Kimble, Chicago, Ill., assignor to Kimble Electric Company. Filed March 22, 1909. The brush is thrown away from the moving contact member by means of a spring which is automatically released when the brush has worn away by a predetermined amount.

942,279. STORAGE BATTERY. David P. Perry, Chicago, Ill., assignor of two-thirds to William Morrison, Chicago, Ill., and one-third to M. A. Lumbard, Des Moines, Ia. Filed October 12, 1903. A metallic cell contains a horizontal cylindrical reticulated negative electride, a positive electrode concentrically within the negative electrode, a cylindrical conductor concentrically within the positive electrode, and a suitable electrolyte.

942,308. IRON HEATED BY ELECTRICITY. John Collicott, Salt Lake City, Utah. Filed June 8, 1909. The heating units are pivotally secured to the interior of the chambered base, the base being provided with a perforated covering.

942,325. ELECTRIC GENERATOR. Gustav A. Huber, New York, N. Y., assignor to Huber Automatic Magneto Signaling Company. Filed February 10, 1908. Connected to the armature is a ratchet wheel co-operating with a swinging pawl which is actuated by a lever.

942,328. IGNITER FOR INTERNAL-COMBUSTION MOTORS, Howard A. Johnston, Toronto, Ontario, Canada. Filed September 27, 1907. One electrode is a cup-shaped member and the other a wire extending from without the cup to within sparking distance of the rim thereof.

942,332. ELECTRIC CONDUCTOR. Isidor Kitsee, Philadelphia, Pa. Filed April 10, 1908. The resistance of each of two conductors comprising together a composite conductor is half or less than half of the resistance between the conductors.

942,334. MECHANICAL CODE-SIGNALING DEVICE. Fritz A. Meissner, Manchester, Va. Filed December 11, 1908. A telephonic apparatus has a circuit closer which can be introduced into various points on a plate having parallel rows of circuit breakers therein.

942,335. INSULATING-SUPPORT FOR HIGH-TENSION CONDUCTORS. Ralph D. Mershon, New York, N. Y. Filed February 5, 1908. A framed structure has insulating members for resolving mechanical forces originating in the conductor into components. Connections between these members and the conductor-carrying means are designed to transmit to the respective members substantially only forces in one direction.

942,349. PROCESS OF PRODUCING FERRO ALLOYS. Edgar F. Price, Niagara Falls, N. Y., assignor to Central Trust Company of New York. Filed June 1, 1907. The charge is smelted in an electric furnace in which the zone of reduction is surrounded and embedded, and the electrodes protected from oxidation and cooling, by a considerable body of the charge. The waste gases are withdrawn laterally in different directions beneath the surface of the charge.

942,350. ELECTRIC FURNACE. Edgar F. Price, Niagara Falls, N. Y., assignor to Electro Metallurgical Company. Filed January 27, 1908. A stack is disposed above the bath and between the vertical series of electrodes so that the air current flowing to the stack passes around and between the electrodes.

943,378. VAPOR ELECTRIC APPARATUS. Leonard E. Dempster, Schenectady, N. Y., assignor to General Electric Company.

Filed March 19, 1904. A filamentary conductor initially connects the several mercury electrodes, and means are provided for nonsimultaneously breaking the connections at the working surfaces of the respective electrodes.

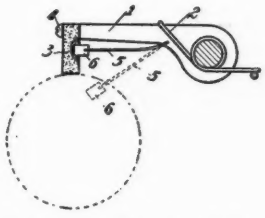
943,379. METHOD OF MANUFACTURING DYNAMO-BRUSHES, ETC. Georg Egly, Berlin, Germany, assignor to Gebruder Siemens Co., Charlottenburg, Germany. Filed January 25, 1907. Triturated silicon is intimately mixed with powder carbon, and the molded product is heated in an atmosphere of nitrogen.

942,382. MOTOR-CONTROLLER. Austin Kimble, Chicago, Ill., assignor to Kimble Electric Company. Filed September 7, 1909. A series of stationary contacts mounted within the motor end cap are successively engaged by contact members secured on the inner face of a rotating ring seated and slidably retained within a groove located in one face of an annular disk the flanges of which are attached to the motor frame.

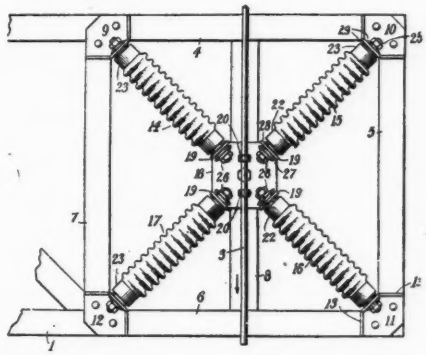
942,396. ELECTRIC DRILL. Purd J. Lincoln, Birmingham, Ala. Filed November 18, 1908. The drill rod is direct-connected to the spindle of an armature rotatable within field coils comprising a central coil, a coil on each side of this, and an end coil for each of the side coils. Means are provided for introducing the central coil and two end coils into an electric circuit alternately in series with the respective side coils to actuate the armature.

942,398. APPARATUS FOR PRODUCING PERFORATED MUSIC-RECORD SHEETS. George Machlet, Jr., Elizabeth, N. J. Filed October 10, 1903. Electrically operated punches are actuated by means of a system of music keys.

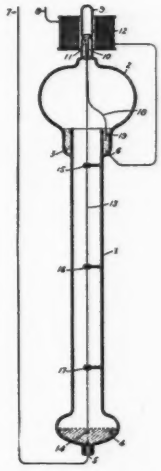
942,401. PORTABLE TELEPHONE. Otto L. Mulot, Brooklyn, N. Y. Filed October 12, 1908. Describes a form of desk telephone.



942,264.—BRUSH-HOLDER.



942,335.—INSULATING SUPPORT FOR HIGH-TENSION CONDUCTOR.



942,378.—VAPOR ELECTRIC APPARATUS.

943,433. ALARM APPARATUS. Harry R. Bretney, Indianapolis, Ind., assignor to John Wocher, John T. Dickson and James S. Cruse, Indianapolis, Ind. Filed January 11, 1909. Is electromagnetically operated.

942,463. METHOD OF AND MEANS FOR REGULATING THE SPEED OF ELECTRIC MOTORS. Robert H. Rogers, Schenectady, N. Y., assignor to General Electric Company. Filed August 5, 1908. One of two cumulatively wound field windings of the motor is maintained open when the motor is heavily loaded and the other is closed when the motor is lightly loaded.

942,468. AUTOMATIC SIGNALING SYSTEM FOR RAILWAYS. George H. Sloane, Boston, Mass., assignor of one-half to Herbert B. Waters and Harold Plimpton. Filed May 26, 1908. Describes an electric block-signaling system.

942,472. ELECTRIC LIGHTING. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. Filed April 21, 1900, Serial. Renewed July 23, 1906. The color of the light from an arc existing within a transparent or translucent envelope is modified by introducing into the arc a color-modifying substance in the condition of a salt of one of the general class of acids forming, or capable of forming, the envelope.

942,488. CONTROLLER FOR ELECTRIC AUTOMOBILES. Henry P. Dodge, Toledo, Ohio. Filed June 5, 1909. Two parallel series of electrical contacts are carried by one of two relatively movable members, and a single contact piece, carried by the other member, may be moved into alinement with either of the series of contacts.

942,491. ELECTRIC SWITCH. William L. R. Emmet and Edward M. Hewlett, Schenectady, N. Y., assignors to General Electric Company. Filed February 14, 1901. Means are provided for breaking the connection between a contact member and its actuator and leaving the latter restrained upon the occurrence of predetermined electrical conditions.

942,508. ELECTRIC CIRCUIT-CONTROLLING RELAY. Burnett Menkin, New York, N. Y. Filed February 3, 1909. There are three electrical circuits, two receiving current from a common source and each including an electromagnet, and the third, which is normally open, including a translating device. The electromagnet in the first circuit controls a means for closing the second circuit, and the electromagnet in the second circuit likewise may close the third circuit.

942,513. SINTERING APPARATUS. Robert Palmer, Larchmont, N. Y., assignor to General Electric Company. Filed February 10, 1909. Describes an arrangement of co-operating, water-cooled, electrically operated clamps.

942,544. ELECTRIC TRANSFORMER AND GOVERNOR. Edward R. Cliff, New York, N. Y. Filed March 5, 1908. Describes an inclosing case for the operative parts of a transformer and governor.

942,550. CONTACT DEVICE FOR SELF-PLAYING MUSICAL INSTRUMENTS AND OTHER APPARATUS. George H. Davis, West Orange, N. J. Filed February 4, 1905. A wire selector finger co-operating with a contact bar or roll over which travels a perforated web, has a loop between its ends whereby its free end may yield in the direction of the travel of the web.

942,555. ELECTRIC RESISTANCE APPARATUS. Max Hankin, Brussels, Belgium. Filed January 5, 1909. A closed conducting metal envelope is packed with particles of a resisting material, into which project two terminals, one from each opposite end.

942,620. ELECTRIC TELEGRAPHY. Joseph A. L. Dearlove, London, England. Filed March 1, 1909. Describes a system of duplex telegraphy.

942,623. AUTOMATIC CUT-OFF. Paul Dixon, Atlanta, Ga. Filed December 20, 1907. A continuously movable (when set) automatically controlled means operates at a predetermined time interval by the movement of another automatic means moving in the opposite direction.

942,646. ELECTRIC IGNITING DEVICE. Joseph A. Jeffery and Benjamin A. Jeffery, San Francisco, Cal. Filed August 15, 1906. The exposed area of either of the terminals is restricted to a limit where the proximity or surface contact therewith of a medium of lesser conductivity will be sufficient to carry the current without heating such medium to disintegration.

942,647. ELECTRICAL CONTACT DEVICE. Charles F. Jenkins, Washington, D. C. Filed August 21, 1908. A movable contact piece may be retarded and suddenly released as it approaches each of several fixed contact pieces.

942,676. SIGNALING SYSTEM. Fae E. Smith, Ames, Ia. Filed July 24, 1908. Describes a signal system for electric trolley railways.

942,704. METHOD OF SECURING METAL CONTACTS TO CARBON ELECTRODES. Stephan Benko, Budapest, Austria-Hungary. Filed July 8, 1909. The head of the electrode is heated to a temperature above the melting point of the metal, whereupon it is impregnated with molten metal, the metal being absorbed by the heated carbon.

942,710. CONNECTION-ROSETTE FOR ELECTRIC WIRES. James L. Burton, Plainville, Conn., assignor of one-half to Frank A. Champlin, East Long Meadow, Mass. Filed July 25, 1908. Eccentrically grooved and ribbed members engage together through contact pieces, and fuse clamps are secured to one of the members.

942,729. ELECTROLYTE AND METHOD OF ELECTRO-DEPOSITING NICKEL. Adward F. Kern, Knovxille, Tenn., assignor of one-half to Percy S. Brown, New York, N. Y. Filed September 7, 1909. A solution containing fluo-silicate of nickel is electrolyzed, using an anode of nickel.

942,730. FLAMING ARC LAMP. George L. Martin, Brooklyn, and Arthur W. Schreiner, Evergreen, Long Island, N. Y., assignors

to said George L. Martin. Filed February 17, 1909. Describes a feed mechanism for flaming arc lamps.

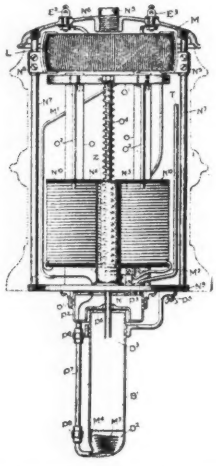
942,763. SIGNALING APPARATUS FOR TELEPHONE SYSTEMS. Roscoe C. Welty, Omaha, Neb. Filed June 2, 1908. Describes a party telephone-line system.

942,787. FLEXIBLE CONDUIT. Charles H. Miller, West Pittsburg, Pa., assignor to Safety-Armorite Conduit Company. Filed July 25, 1907. A nonmetallic flexible conduit for electric wires has an inner layer with a smooth interior face, and a tubular braided or woven fabric surrounding the inner layer and saturated with a fireproofing substance.

942,788. CONDUIT FOR ELECTRIC WIRES. Charles H. Miller, West Pittsburg, Pa., assignor to Safety-Armorite Conduit Company. Filed July 25, 1907. The inner lining of woven or braided strips has its weft and warp spirally wound in opposite directions.

942,789. FLEXIBLE ELECTRIC CONDUIT. Charles H. Miller, West Pittsburg, Pa., assigner to Safety-Armorite Conduit Company. Filed July 25, 1907. The inner composition-covered fabric is inclosed by a spirally wound wooden strip impregnated with a fireproofing composition, this wooden strip being inclosed by a wrapping and the whole inclosed by a waterproofed woven or braided fabric.

942,790. FLEXIBLE CONDUIT FOR ELECTRIC WIRES. Charles H. Miller, West Pittsburg, Pa., assignor to Safety-Armorite Conduit Company. Filed July 25, 1907. The innermost tube is airtight and watertight and is surrounded by a helical paper wrapping, this in turn being wrapped with muslin impregnated with an adhesive composition, the whole being finally covered by a braided or woven tubular fabric.



942,472.—ELECTRIC LIGHTING.

942,807. TELEGRAPHIC REPEATING APPARATUS. William E. Athearn, New York, N. Y., assignor to American Telephone and Telegraph Company. Filed June 12, 1909. The repeater comprises two transmitting sections, a primary relay operated by a transmitter and in turn operating a secondary relay, and circuit-controlling means for the secondary relay.

942,814. MULTIPLE TELEGRAPH. Stephen D. Field, Stockbridge, Mass., assignor to the Western Union Telegraph Company. Filed June 17, 1909. A differentially wound relay has its differential windings one in a main line and one in an artificial line of the system, and another relay has its coils connected to the main and artificial lines in bridge relation with respect to the first relay and having an inductive capacity greater than that of the main and artificial line coils of the first relay.

942,815. RELAY. Stephen D. Field, Stockbridge, Mass., assignor to the Western Union Telegraph Company. Filed June 17, 1909. There are three electromagnets, one a main magnet for the movably mounted armature, one a holding magnet for the armature, and the third an auxiliary magnet acting upon the armature in the same direction as the holding magnet.

942,844. AUTOMATIC TELEGRAPH. Louis M. Potts, Baltimore, Md., assignor to the Rowland Telegraphic Company. Filed July 6, 1905. A progressive contact-maker connects the main-line transmitter into each of several groups of electric circuits (for operating the transmitter) successively, and a primary concrolling device consists of a prepared sheet having code impressions thereon arranged in a series of groups of transverse lines, each group of lines of impression corresponding to a line of matter to be transmitted and each adapted to control a separate group of the circuits.

942,861. GAS-ANALYZER FOR FURNACES. Cyprien O. Mailloux and Henry J. Westover, New York, N. Y. Original application filed February 7, 1907. Divided and this application filed April 22, 1907. A directing valve is moved electromagnetically.

942,867. MAGNETIC CLUTCH. Henry W. Ravenshaw, Hanwell, England. Original application filed February 28, 1907. Divided and this application filed March 29, 1909. The magnetic circuit is completed out through an intermediate element (located between the annular electromagnet and its annular keeper) and back through the shaft.

942,871. VAPOR ELECTRIC APPARATUS. Howard I. Wood, Schenectady, N. Y., assignor to General Electric Company. Filed December 17, 1903. A conductor, having one end resting on a vaporizable electrode, may be subjected to the influence of an intersecting magnetic field.

942,874. ELECTRIC HEATER. George E. Stevens, Lynn, Mass., assignor to General Electric Company. Filed May 29, 1907. The fluid is delivered to the heater under pressure, the flow of fluid and the circuit of the heater being controlled by means operated by the fluid pressure.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired December 13, 1909:

487,703. ELECTRIC METER. Chas. W. Ayton. New York, N. Y.

487,735. CONDUIT FOR ELECTRIC RAILWAYS. John W. Hayden, Fort Wayne, Ind.

487,755. ARMATURE FOR ELECTRO-MAGNETIC MACHINES. Robert Lundell, New York, N. Y.

487,795. MULTIPLE-SWITCHBOARD SIGNAL. Giles Taintor, Keene, N. H.

487,796. SYSTEM OF ELECTRICAL TRANSMISSION OF POWER. Nikola Tesla, New York, N. Y.

487,813. ELECTRIC-RAILWAY TROLLEY. Adolf Worner, Buda Pesth, Austria-Hungary.

487,816. AUTOMATIC SAFETY DEVICE FOR DYNAMO-ELECTRIC MACHINES. Francis B. Badt, Chicago, Ill.

487,834. MANUFACTURE OF SECONDARY-BATTERY ELECTRODES. William W. Griscom, Haverford, Pa.

487,839. GALVANIC BATTERY. Harry T. Johnson, New York, N. Y.

487,846. CASING FOR BASES OF INCANDESCENT LAMPS. Geo. R. Lean, Boston, Mass., and Chas. B. Burleigh, Chelsea, Mass.

487,852. MULTIPLE-SWITCHBOARD CIRCUIT. Alfred H. McCulloch, Boston, Mass.

487,853. MULTIPLE-SWITCHBOARD BUSY-TEST CIRCUIT AND APPARATUS. Jas. J. McQuarrie, Boston, Mass.

487,854. BUSY-TEST APPARATUS FOR MULTIPLE SWITCHBOARDS. Jas. L. McQuarrie, Boston, Mass.

487,881. AUTOMATIC SWITCH. Nelson Newman, Springfield, Ill.

487,890. MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS. Casimir Pauthonier, Boston, Mass.

487,904. SIGNALING DEVICE FOR RAILWAYS. Zdenko Krulis, Chicago, Ill.

487,936. AUTOMATIC KEYBOARD-OPERATOR. Henry S. Prentiss, Elizabeth, N. J.

487,981, 487,982 and 487,983. PRINTING TELEGRAPH. Chas. L. Buckingham, New York, N. Y.

487,984. SYNCHRONOUS MULTIPLE-TELEGRAPH. Chas. L. Buckingham, New York, N. Y.

487,985 and 487,986. PRINTING TELEGRAPH. Chas. L. Buckingham, New York, N. Y.

487,996. ELECTROLYTIC APPARATUS. Thomas Craney, Bay City, Mich.

488,002. LIGHTNING ARRESTER. Wm. R. Garton, Keokuk, Iowa.

488,012. ELECTRIC GAS-LIGHTER. Lucien M. Kilburn, Council Bluffs, Iowa, and Scott Van Etten, Omaha, Neb.

488,013. ELECTRIC BELT. Ole Kjorstad, Eau Claire, Wis.

488,016. ARMATURE FOR ELECTRIC MACHINES. Benjamin G. Lamme, Pittsburg, Pa.

488,022 and 488,023. ELECTRIC RAILWAY TROLLEY. David Mason, New York, N. Y.

488,027. ELECTRIC COUPLING. John J. Purcell, Washington, D. C.

488,033. SPRING JACK SWITCH. Chas. E. Scribner and Ernest P. Warner, Chicago, Ill.

488,034. MEANS FOR PREVENTING INDUCTION IN CABLES OF MULTIPLE SWITCHBOARDS. Chas. E. Scribner, Chicago, Ill.

488,035, 488,036 and 488,038. MULTIPLE SWITCHBOARD SYSTEM FOR TELEPHONE EXCHANGES. Chas. E. Scribner, Chicago, Ill.

488,041. ELECTRIC MOTOR. Imle E. Storey, Boulder, Colo.

488,053. TEST CIRCUIT FOR MULTIPLE SWITCHBOARDS. Oro A. Bell, Brooklyn, N. Y.

488,123. ELECTRIC SAFETY CUTOUT. Henry S. Keating, London, England.

488,138. ELECTRIC SIGNAL-CIRCUIT. John V. Young, Boston, Mass.